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ABSTRACT

This instructor's guide contains the materials required to teach the fruit and nut production component of a competency-based horticulture course that is intended to provide students with technical skills and the basic business skills to run a successful operation or be a productive employee. The following topics are covered in the 12 instructional units: identify fruits and nuts; select and prepare a site for fruit and nut crops; propagate, plant, maintain, fertilize, and irrigate fruit and nut crops; control pests in fruit and nut production; harvest fruits and nuts; perform postharvest functions; inventory, ship, and maintain merchandise; and sell fruit and nut crops. Each unit contains some or all of the following: performance objectives, suggested activities for instructors, information sheets, optional supplemental instructional materials, activity sheets, assignment sheets, job sheets, written tests, test answers, and unit reference lists. Throughout the curriculum, academic skills training is combined with applied technology instruction, and a system of icons is used to help instructors identify activities into which training in the following basic skills has been infused: reading, science, creative thinking/problem solving, writing, oral communication, employability, math, interpersonal skills, and social studies. A basic skills documentation matrix correlates skills with units of instruction. (MN)

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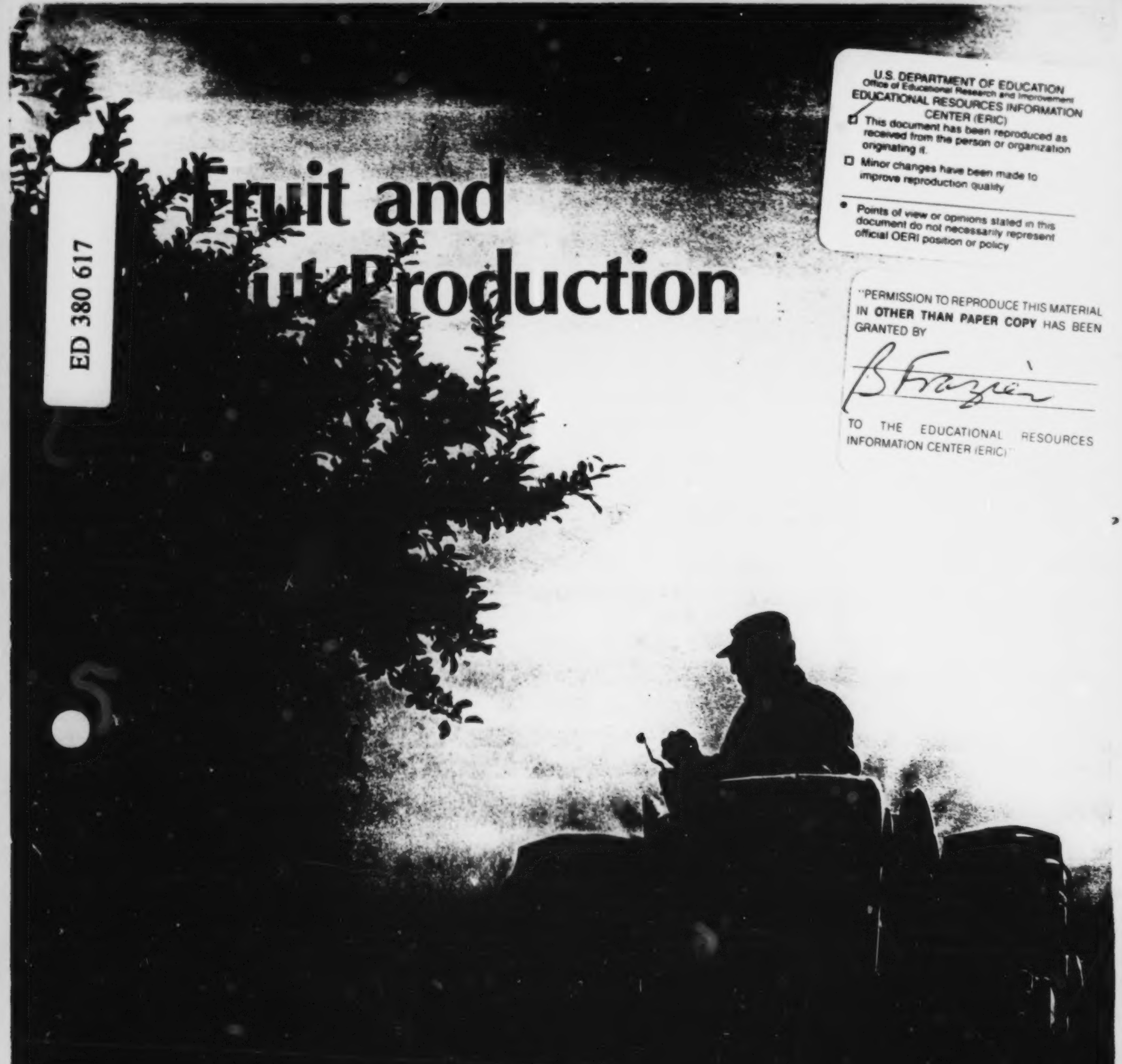

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CE 068 537

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CIMC
Teacher Edition

Oklahoma Department of
Vocational and Technical Education
1500 West Seventh Avenue
Stillwater, OK 74074-4364

Fruit and Nut Production

Developed by the
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for the Division of
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FOREWORD

The Oklahoma Department of Vocational and Technical Education is committed to responding to the needs of industry and agricultural education students. The fruit and nut production industry is important to the economy of Oklahoma and provides many opportunities for students who possess the necessary skills.

Fruit and Nut Production continues the horticulture series and provides students with the technical skills as well as the basic business skills to operate a successful operation or to be a productive employee.

Eddie Smith, State Supervisor
Agricultural Education
Oklahoma Department of Vocational
and Technical Education

PREFACE

Oklahoma's horticulture industry continues to grow and has become an important part of the economy of the state. Industry leaders from across the state have emphasized the need for well-trained workers in this specialized occupation. This publication was designed to further develop skills acquired in other horticulture courses. With proper implementation, *Fruit and Nut Production* will help students acquire the skills necessary to become the productive workers that employers want to hire.

Randy Kirk, Curriculum Specialist
Curriculum and Instructional
Materials Center
Oklahoma Department of Vocational
and Technical Education

ACKNOWLEDGEMENTS

My sincere appreciation goes to the many people whose hard work went into the development of this publication:

- Members of the development committee--Ernest Fisher, Porter, Oklahoma; Gordon Barlow, Noble Foundation, Ardmore, Oklahoma; Gordon Couch, Luther, Oklahoma; Daniel Smith, Stilwell, Oklahoma; John Williams, Morris, Oklahoma; and Glen Taylor, Oklahoma State University--whose expertise laid the groundwork for and provided guidance during the writing and development.

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- Billie Frazier, Terri Tomson and the rest of the CIMC staff.

- Eddy Smith, State Supervisor, and Phil Berkenbile, District Supervisor of the Oklahoma Department of Vocational and Technical Education Agriculture Division.

- Claire Dickey, CIMC technical writer, who put in many hours on this project.

- With help from all the people listed above and more, Gina Lauer and Sandra Dutreau Perky Williams wrote this book. They are responsible for pulling together a multitude of resources into a concise package full of useful activities.

Randy Kirk, Curriculum Specialist
Curriculum and Instructional
Materials Center
Oklahoma Department of Vocational
and Technical Education

USE OF THIS PUBLICATION

INSTRUCTIONAL UNIT

Fruit and Nut Production contains twelve units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for the teacher, Extensions and Options, information sheets, job sheets, practical tests, written tests, and answers to assignment sheets, and written test all of which are included in the instructor edition. The student workbook includes the objective sheets, information sheets, supplements, activity sheets, assignment sheets, and job sheets. Pretest, practical tests, and written tests may be duplicated for classroom use or additional copies may be purchased by calling 1-800-654-4502, in Oklahoma 1-800-522-5810, ext. 589.

All of the unit components "zero in" on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following:

- Amount of material that can be covered in each class period.
- Skills that must be demonstrated.
  - Supplies and equipment needed
  - Amount of class time needed for demonstrations
  - Amount of time needed for student practice
- Supplementary materials, including print and non-print media, that must be ordered.
- Resource people who must be contacted.

Objective Sheet (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction, and specific objectives stating the performance necessary to reach the unit objective.

The unit objective states the overall goal of the unit. It tells what the student should be able to do and what standard will be used to see whether the student can do it. Specific objectives outline the teaching sequence of the competencies required to meet the unit objective.

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objective can also help determine teaching strategies and instructional methods. Instructors should prepare for each unit by deciding how each objective can be best taught.

Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages) – **Instructor's Edition only**

This component is included only in instructor material. The suggested activities page assists the instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery, application, and evaluation during the instructional process. The instructor should read the suggested activities before teaching the units to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the instructor will vary according to the particular unit.

References used in the development of each unit are listed in the "Suggested Resources" section, along with print and non-print media that may be used to teach the unit. These materials can be used by the instructor to supplement his or her knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Information Sheets (green pages)

The information sheet provides "must know" content essential for meeting the cognitive objectives on the knowledge and comprehension level of Bloom's taxonomy of educational objectives. The information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. It also may be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and instructors to add notes that supplement, localize, personalize, or provide motivation for each unit.

The information sheet may include notes, cautions, or warnings. These should be discussed carefully and thoroughly. Notes are short verbal additions to the information sheet or procedural outline that provide nice-to-know and decision-making information. A note may tell the student what to watch for or to consider at a given step. It may explain when a step may not be applicable. Notes offer guidance that may help the student understand the process and do it more efficiently. **Cautions** are advisories that tell the student how to avoid causing minor personal injury or equipment damage. **Warnings** are advisories that tell the student to avoid serious personal injury or death to the student persons in the workplace, or users of the project or the procedure.

Supplements (green pages)

Supplements include instructions that could be used for solving problems or reinforcing the enrichment of learning. The information presented in a supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignment or job sheets. While supplements are not tested over directly, they may be used to assist in meeting the performance objectives.

Assignment sheets are intended to provide students with practice in exercising higher-order thinking skills. Often, assignment sheets will contain case studies or story problems or other situations in which the student must analyze the circumstances and determine correct responses. Assignment sheets may be given to the students for completion in class or for homework. Answer sheets are provided.

Instructional Supplements (pink pages) — **Instructor's Edition only**

Instructional Supplements provide suggestions for teaching the basic skills included in each activity sheet, assignment sheet, or job sheet.

Assignment Sheets (tan pages)

Assignment sheets provide students with information and exercises to problems that address learning levels at or above the application level of Bloom's taxonomy. Assignment sheets provide written exercises for instruction and practice of a specific objective. The introduction to the assignment sheet explains how the assignment sheet relates to the subject area and unit objectives and may provide instructional information or refer students to another component for such information.

Job Sheets/Skill Test Record (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure to complete each task or job. Diagrams, photographs, and illustration are provided to assist students in achieving the skill.

The instructor should demonstrate the procedure outlines in each job sheet. Further more, the instructor needs to localize the procedure according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Written Test (yellow pages) – **Instructor's Edition only**

This component provides criterion-references evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper-pencil and performance objectives must be evaluated. If objectives have been added, deleted, and modified, appropriate changes should be made on the test.

The test may be written or oral. It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered.

The acceptable response on a unit test, eighty-five (85) percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each individual question. The final unit grade should be obtained by using the "paper-pencil" score along with teacher evaluations of student demonstrations of the desired skills.

Answers to Assignment Sheets and Written Tests (pink pages) – **Instructor's Edition only**

These components are designed to assist the instructor in evaluation of student performance. They are available in the teacher's edition only.

PAGE NUMBERING

Each publication for the Curriculum and Instructional Materials Center is usually assigned a specific abbreviation. ***Fruit and Nut Production*** has not been abbreviated. Each unit will be recognized by the unit number in roman numerals. Each unit in the publication begins with page 1. Each page number gives the component name, book title, unit number, and page number within the unit. Since CIMC publications are loose-leaf, this system of page numbering was recently adopted so that pages from different manuals would not get mixed up. The page number for the objective sheet in **Identify Fruits and Nuts**, which is unit I, would look like this:

> OBJECTIVE SHEET - **Fruit and Nut Production**
> CIMC - 1 - 1

METHODS OF DISSEMINATING MATERIAL

For best results, provide student materials for each student. Student workbooks contain objective sheets, information sheets, supplements, transparency masters, activity sheets, assignment sheets, and job sheets. Pretest, practical tests, and written tests are packaged separately for students, and can be stored until needed. Students should be allowed to take their materials home at the end of the course.

TEACHING METHODS

Keeping students motivated is a challenge. Supplement the objectives by providing the "why," personal experiences, and current information. If you are going to teach the material in a group setting, prepare for the unit be deciding the best way to teach each objective and allow for student input.

If you are going to follow the plan for individualized instruction, provide opportunities that will allow each student to become involved in planning for and being responsible for his or her own education.

COMPETENCY PROFILES

A competency profile is available for each CIMC publication. Competency profiles document student performance. The profile contains a list of the specific job competencies that a student should achieve before leaving the training program. Profiles should be distributed as required.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

For a free catalog, a list of new publications, or other instructional materials information call 1-800-522-5810, extension 589.

RESALE

BASIC SKILLS IN CURRICULUM

Since its inception in 1969, the Curriculum and Instructional Materials Center (CIMC) of the Oklahoma Department of Vocational and Technical Education has provided quality, competency-based instructional materials for vocational training programs. During this time, the CIMC has been mindful of the importance of reinforcement (and sometimes remediation) of students' academic skills as they progress through vocational training, and has always included activities in its materials to enhance and promote use of these skills.

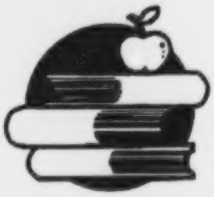
In response to changing job requirements, federal and state legislatures are enacting laws setting stringent basic skills requirements for nonvocational **and** vocational education. State legislatures are increasing basic skills accountability for teachers and school administrators. The recently enacted Carl D. Perkins Vocational and Applied Technology Education Act Amendments of 1990 (P.L. 101-392) mandates academic skills development in vocational training. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in the basic skills.

As noted earlier, it is not new for CIMC materials to contain information and activities that develop basic skills competencies in students taking vocational training. What **is** new is the documentation or flagging of basic skills in CIMC materials, and further enhancement of basic skills activities. To accomplish this, the CIMC has developed a "Five Point Approach to the Integration of Basic Skills into the Curriculum." Following is a brief description of this process.

I. Basic Skills Icons

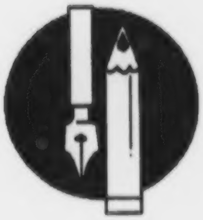
To assist teachers and students in identifying activities that promote basic skills development, the CIMC has implemented a marking system that uses simple graphic symbols, or icons, to denote which of nine general basic skill categories is being emphasized. These icons are located in the left margins of assignment, activity, and job sheets. The nine basic skill areas are as follows:

Reading Skills



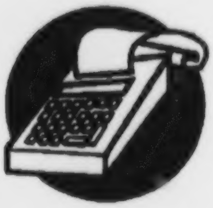
The activities identified by this icon deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials.

Writing Skills



Tasks identified with this icon promote development of skills in written communication ranging in complexity from filling out forms to the written expression of ideas and concepts related to vocational exploration or performance.

Mathematics Skills



This icon identifies activities that develop vocationally related skills in computation; measurement and estimation; selection and application of appropriate mathematical process; and collecting, displaying, or interpreting data.

Science Skills

The science icon marks activities that are related to the development of skills in either the physical or biological sciences. These skills stress occupationally related applications of science and technology.

Oral Communication Skills

This icon identifies activities that promote development of effective speaking and listening skills. They include practice in such areas as speaking techniques, word choice, nonverbal messages, use of communication media, and using active listening techniques.

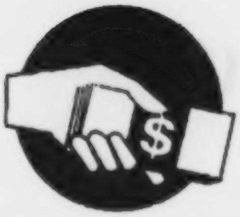
Interpersonal or Relating Skills

Activities that deal directly with skills in relating to others are marked with this icon. This includes areas such as group processes and dynamics, negotiation, dealing with conflict, and leadership/motivation.

Creative Thinking and Problem Solving Skills

This icon identifies activities that stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives/outcomes, and developing solutions.

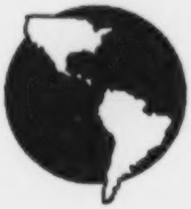
Employability Skills



Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks and more general items such as career planning, job search, business etiquette, and maturing in one's work environment.

Social Studies Skills

This icon is used to identify activities that stress competencies in fields relating to human society and its distribution and relationships. This includes all the social sciences such as history, economics, geography, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.



Some activities in the CIMC materials develop skills in more than one of the nine basic skill areas. In cases where the relative strengths of the skill elements are clearly discernable, the icon used is the one judged to be the primary, or the most heavily emphasized, activity. When there is no clear-cut difference between importance of skill area, multiple icons are used.

II. Enablers

Once the **general** basic skill activity has been identified by an icon, the CIMC takes the process one step further by indicating the **specific** skills that are addressed in an activity. This is accomplished by using enabling skills, or "enablers."

Lists of enablers, or specific skills required for each activity, have been developed at CIMC for each of the nine basic skills areas. The enablers have been grouped into sets of related skills under each icon. The list of general skill categories under each icon is as follows:

Reading Comprehension Skills
Research and Reference Skills
Functional Reading Skills

Language Skills
Composition Skills
Research Skills
Functional Writing Skills

Operation and Calculation Skills
Math Application Skills
Data Analysis and Display Skills
Functional Math Skills

General Science Skills
Life Science Skills
Physical Science Skills
Earth Science Skills

Oral Presentation Skills
Listening Skills
Interactive Communication Skills

General Relating Skills
Teamwork/Cooperative Skills
Leadership/Influencing Skills

Enablers
Cognitive Activities Skills

Job Search/Selection Skills
Job Acquisition/Development Skills

Information Analysis Skills
Social Studies Application Skills
Functional Social Studies Skills

Applicable enablers, grouped under their general categories, are listed beneath each icon in the left-hand margin of the activity, assignment, and job sheets. For example, an exercise that requires a student to conduct library research would make necessary the use of specific reading comprehension and research and references skills. The basic skills that the exercise is promoting would be depicted in the margin as follows:

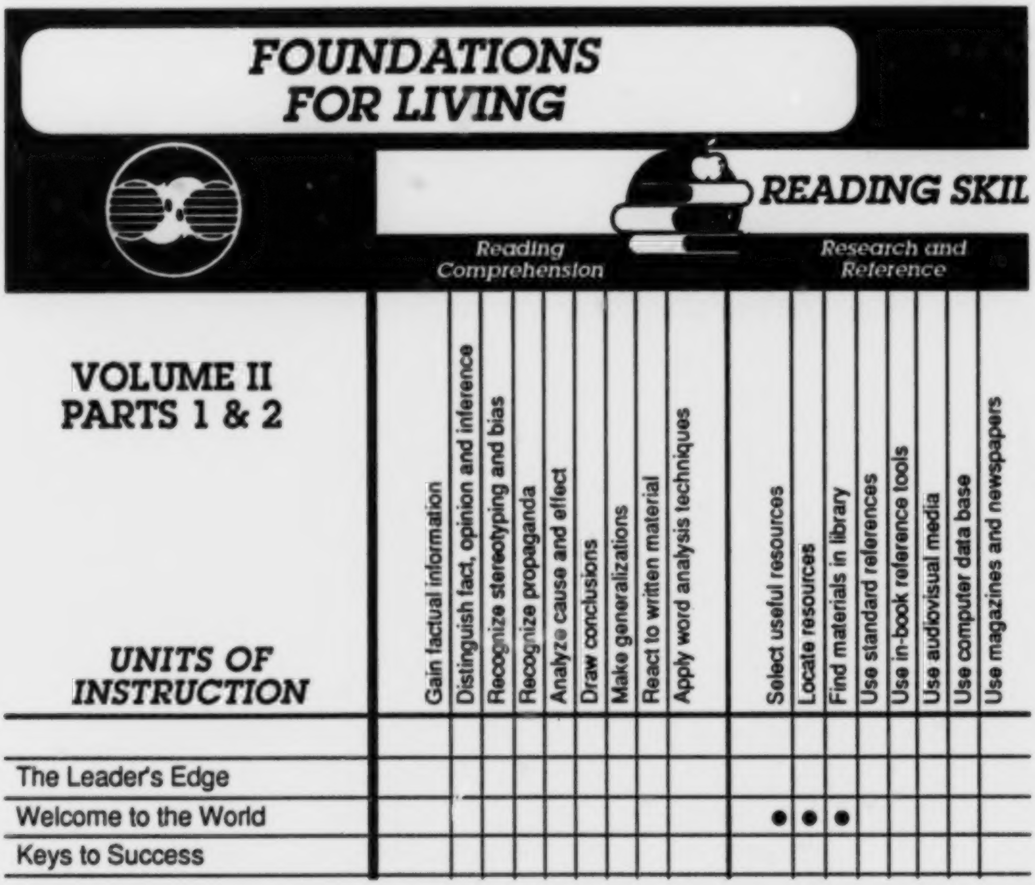
Reading Comprehension Skills
- Gain information

Research and Reference Skills
- Select useful resources
- Find materials in library

[Text]

III. Basic Skills Documentation Matrix

The third component of the CIMC basic skills instructional plan is the "Basic Skills Documentation Matrix." This attractive 22" x 34" wall hanging graphically depicts the basic skills in a CIMC curriculum guide unit by unit. It should be helpful to teachers in planning their instruction, and to administrators as documentation that basic skills **are** being addressed during the vocational training. Two copies of the matrix are included with each order of a teacher's book.



FOUNDATIONS FOR LIVING

READING SKIL

VOLUME II PARTS 1 & 2

	Reading Comprehension										Research and Reference							
UNITS OF INSTRUCTION	Gain factual information	Distinguish fact, opinion and inference	Recognize stereotyping and bias	Recognize propaganda	Analyze cause and effect	Draw conclusions	Make generalizations	React to written material	Apply word analysis techniques		Select useful resources	Locate resources	Find materials in library	Use standard references	Use in-book reference tools	Use audiovisual media	Use computer data base	Use magazines and newspapers
The Leader's Edge																		
Welcome to the World											●	●	●					
Keys to Success																		

Matrices have been developed for most CIMC publications. For more information on those available for other programs, call CIMC Resale, 1-800-522-5810 Ext. 589 in Oklahoma, and 1-800-654-4502 in all other states.

IV. Suggested Evaluative Criteria

In some instances a "Suggested Evaluative Criteria" chart is included on assignment sheets to assist the teacher in scoring the basic skills portion of the assignment. As the title implies, these are suggestions only, and should be of use to the vocational teacher who has little experience or training in teaching or evaluating academic exercises such as composition writing. The criteria will usually appear with writing, oral presentation, or major project assignments. For example, suggested evaluative criteria given for a writing assignment would recommend number of points to be assigned for neatness of report, content, use of note cards, spelling, and grammar.

SUGGESTED
EVALUATIVE CRITERIA

1.	Note cards with proper information	10 points
2.	Bibliography	5 points
3.	Footnotes	5 points
4.	Language skills (grammar, spelling, capitalization, punctuation, complete sentences)	15 points
5.	Composition skills (topic sentences, introductory paragraph)	15 points
6.	Content	45 points
7.	Neatness of report	5 points
	TOTAL	100 points

V. *Instructional Supplement*

Often job, activity and/or assignment sheets are accompanied by a "Basic Skill Instructional Supplement." These instructional supplements are grouped together; e.g., all job sheet instructional supplements will appear as a group in each unit. These series will appear directly in front of the exercises with which they are to be used--job, activity, or assignment sheets.

The supplement is a tool for the instructor to use in helping students apply the basic skills in their assignments. Some supplements are appropriate for use with all students; some are for use only with those students who do not understand the academic skills called for in the exercise. The supplement will be similar in format and content to the Suggested Activities portion of the CIMC materials.

INSTRUCTIONAL SUPPLEMENT	***USE AUTOMOTIVE SERVICE REFERENCE MATERIALS*** ***I***
ASSIGNMENT SHEET	Skill development for: MATHEMATICS • Introduce the assignment to the students by discussing with them the purpose of graphs. Stress the ability of graphs to represent numerical data in easy-to read, visual format. • Use Student Supplement 3, "Interpreting Graphs," to review with students the major types of graphs and how they should be read.

******

The five basic skills components:

- Icons
    - Enablers
        - Matrix
            - Suggested Evaluative Criteria
                - Basic Skills Instructional Supplements

are currently being phased into CIMC publications in graduated stages. While not all publications presently contain all five components, missing components will be added as books are revised and reprinted.

Lynna Ausburn, Ph.D.
Development Coordinator

Billie Frazier
Copy Specialist

OBJECTIVE SHEET

IDENTIFY FRUITS AND NUTS

I

INTRODUCTION

If you are planning on a future in the fruit and nut production industry, there are many things you must know. To choose suitable crops for your region, you must know the special requirements of each crop. You should be familiar with types of fruits and nuts and how they grow. The more you know about particular crops, the better qualified you are as a grower caretaker, picker, or worker in one of the many facets of fruits and nut production.

UNIT OBJECTIVE

After completing this unit, the student will be able to describe types of fruits and nuts, parts of the plants, and understand hardiness zones. The student will demonstrate these competencies by completing the assignment sheet and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to

1. Match terms associated with fruits and nuts to their correct definitions.
2. Select from a list the main fruit types.
3. Match fruit groups to their climatic requirements.
4. Identify parts of a tree.
5. Identify parts of a strawberry plant.
6. Identify parts of a liana
7. Identify parts of a bramble.
8. Describe the two types of dwarfed fruit and nut trees.
9. Determine suitable fruits or fruit varieties for a particular area based on hardiness zones. (Assignment Sheet 1)

SUGGESTED ACTIVITIES

IDENTIFY FRUITS AND NUTS

I

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

- Obtain maps of Oklahoma for students to use when completing Assignment Sheet 1.
- Obtain current statistics on the economic importance of fruit and nut production to the United States and to your particular state.
- Obtain samples of fruits and nuts, including the various varieties or cultivars.

DELIVERY

Objective 1: Match terms associated with fruits and nuts to their correct definitions.

Objective 2: Select from a list the main fruit types.

Objective 3: Match fruit groups to their climatic requirements.

- Discuss terms associated with fruits and nuts using the Information Sheet.

- Show students examples of the various types of fruits described in the Information Sheet. Cut open the fruit to show students how they differ at the core.
- Have students make lists of fruits and nuts and identify them according to the five types.
- Discuss the influence of climate on fruit and nut production. Talk about the temperature ranges of tropical, subtropical and temperate climates.
- Use a large map of the United States to point out tropical, subtropical and temperate regions.

Objective 4: Identify parts of a tree.

- Take students outdoors and go over the parts of a tree. Describe the function of each part.
- Discuss how different fruit and nut trees can be identified by leaves, bark, flowers, etc.

Objective 5: Identify parts of a strawberry plant.

Objective 6: Identify parts of a liana.

Objective 7: Identify parts of a bramble.

- Bring a strawberry plant to class and go over the parts of the plant. Describe the function of each part.
- Bring in an example of a liana -- grape, etc., and go over the various parts and the function of each part.
- Bring in an example of a bramble – blackberry, raspberry, etc. and discuss which brambles grow best in your state and why. Point out the parts of the bramble and the function of each.

Objective 8: Describe the two types of dwarfed fruit and nut trees.

- Bring in examples or show illustrations of dwarf fruit trees and show how they differ from standard-sized fruit trees.
- Explain the benefits and drawbacks of using dwarf trees in orchard production.
- Discuss Supplement 2, "How Big Is A Fruit Tree?" which covers the ways dwarf trees are produced and describes differences between dwarfs and standard trees.

APPLICATION

Objective 9: Determine suitable fruits or fruit varieties for a particular area based on hardiness zones. (Assignment Sheet 1)

- Review hardiness zones -- particularly those in your state and region. Have students complete Assignment Sheet 1.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Electronic Media

- *4-H Horticulture Identification,* OSU Extension Video Tape, VT 100. Available from OSU Agriculture Information Library, Oklahoma State University, Stillwater, OK 74078-0550; phone (405) 744-6886.

Print Media

- *A Calendar For Pecan Growers,* OSU Extension Fact Sheet No. F-6200. Available from Central Mailing Services, Oklahoma State University, Stillwater, OK 74078-0550.
- *Pecan Varieties of Oklahoma,* OSU Extension Fact Sheet No. F-6201. Available from Central Mailing Services, Oklahoma State University, Stillwater, OK 74078-0550; phone (405) 744-6886

UNIT REFERENCES

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- Bishop, Douglas D., Lark P. Carter, Stephen R. Chapman, and William F. Bennett. *Crop Science and Food Production,* Gregg Division, McGraw-Hill Book Company: New York, NY, 1983.
- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications: Gainesville, FL, 1983.
- *Fruits and Berries.* The American Horticultural Society: Mount Vernon, VA, 1982.
- Galletla, Gene J., and David G. Himelrick, eds. *Small Fruit Crop Management.* Prentice Hall: Englewood Cliffs, NJ, 1989.
- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Company: Houston, TX, 1978.
- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction, 1982.
- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.
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INFORMATION SHEET	IDENTIFY FRUITS AND NUTS	I

OBJECTIVE 1 **Match terms associated with fruits and nuts to their correct definitions.**

- **biennial** – a plant that requires two seasons to complete its life cycle, the first for vegetative growth, the second to flower and fruit

  EXAMPLE: Blackberry, raspberry, dewberry

- **bramble** – a perennial plant that has a biennial growth and fruiting habit
- **deciduous** – a plant that loses its leaves during the fall
- **evergreen** – a plant that keeps its foliage through the winter months
- **fruit** – a ripened or mature ovary; the result of a fertilized flower; also, the seed-bearing part of a plant
- **liana** – woody vine

  EXAMPLE: Grape

- **perennial** – a plant that lives more than two years
- **pH** – a measure of concentration of hydrogen ions in a soil or solution

  NOTE: A pH of 7 is neutral; less than 7 is acidic and more than 7 is alkaline.

- **pomology** – the study of fruits; including cultivated tree fruits, nuts, grapes, and berries
- **rootstock** – the lower parts of a grafted plant which provides the root system for the plant
- **scion** – (SIGH-Un) plant portion that is grafted or inserted into the rootstock and produces the fruit
- **vine** – a plant that can grow along the ground or has tendrils that allow it to grasp or cling to walls or other support structures

  EXAMPLE: Watermelon

OBJECTIVE 2

Select from a list the main fruit types.

- **Pome** – A fruit with a well-defined core containing more than one seed surrounded by fruit flesh.

  EXAMPLES: Apple, pear

- **Stone (or drupe)** – A fruit with a hard pit surrounded by fruit flesh.

  EXAMPLES: Peach, plum, cherry

- **Nut** – Comprised of a seed or kernel, shell, and hull.

- **Multiple fruit** – A fruit derived from a collection of "inside-out" flowers or inflorescence.

  EXAMPLE: Fig

- **Small fruit** – Fruits that do not grow on a tree, and in general, grow close to the ground on small bushes, plants or vines; fruit is smaller than tree fruits.

  EXAMPLES: Grapes, strawberries, blueberries. Also, raspberries and blackberries which are also called bramble fruit.

OBJECTIVE 3

Match fruit groups to their climatic requirements.

NOTE: Fruits and nuts are grown in many different climates, and the type of climate often dictates what kind of fruit will grow in a certain region. Some horticulturists group fruits according to these temperature requirements.

- **Temperate fruits** – Deciduous fruits; these include pome fruits, stone fruits, tree nuts, and berries

  NOTE: Blueberries are semi-evergreen in Oklahoma and some other states.

- **Tropical fruits** – Evergreen fruits, such as bananas and papayas

- **Subtropical fruits** – Either deciduous or evergreen; these include citrus fruits.

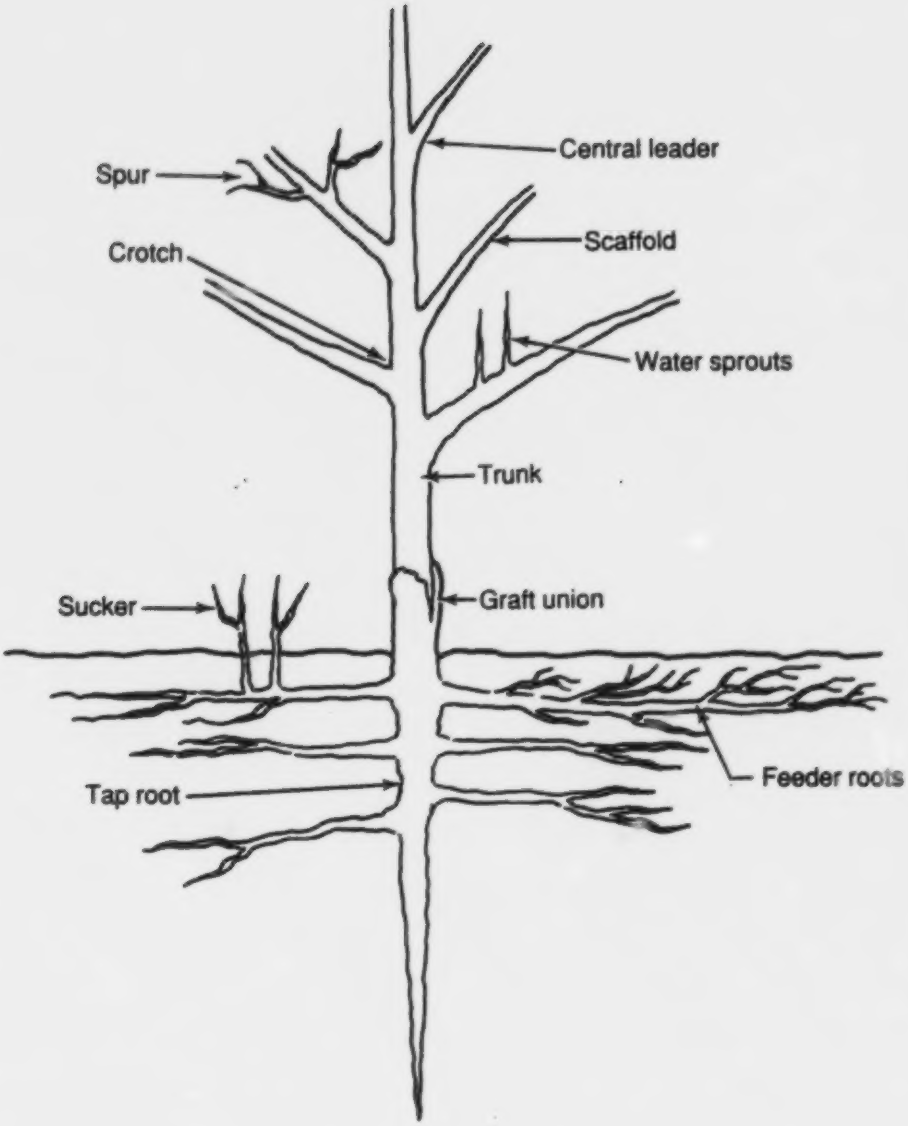
  NOTE: Subtropical and tropical crops are primarily grown in Florida, Texas, Arizona, California, and Hawaii.

OBJECTIVE 4 **Identify parts of a tree.**

- **Central leader** – Dominant growing point found in the top of the tree
- **Crotch** – Area where large branches join the trunk
- **Feeder roots** – Roots that are just below the surface; they absorb most of the oxygen and minerals that go to the tree or plant
- **Graft union** – The section where the scion has been grafted to the rootstock
- **Scaffold** – Limb that branches off of the central leader of the tree
- **Spur** – Small branch that grows only 1/2 inch or less per year; site of fruit production in some trees

  NOTE: Spurs are common on apple, apricot, pear and plum trees.

- **Sucker** – Vigorous leafy shoot arising from roots or from the base of the tree
- **Tap root** – Primary root that continues to grow deeper into the soil; it is used for food storage, keeping the tree upright, and absorbing deep water
- **Trunk** – Part of the tree that connects the root system and branches
- **Water sprout** – Vegetative shoot arising from buds on the trunk or large branches


Spur
Central leader
Crotch
Scaffold
Water sprouts
Trunk
Sucker
Graft union
Tap root
Feeder roots

OBJECTIVE 5 **Identify parts of a strawberry plant.**

- **Leaves** – The leaves, as well as the fruit, require significant attention. There is a direct correlation between the number of leaves per plant in the fall and the amount of fruit produced the following spring.

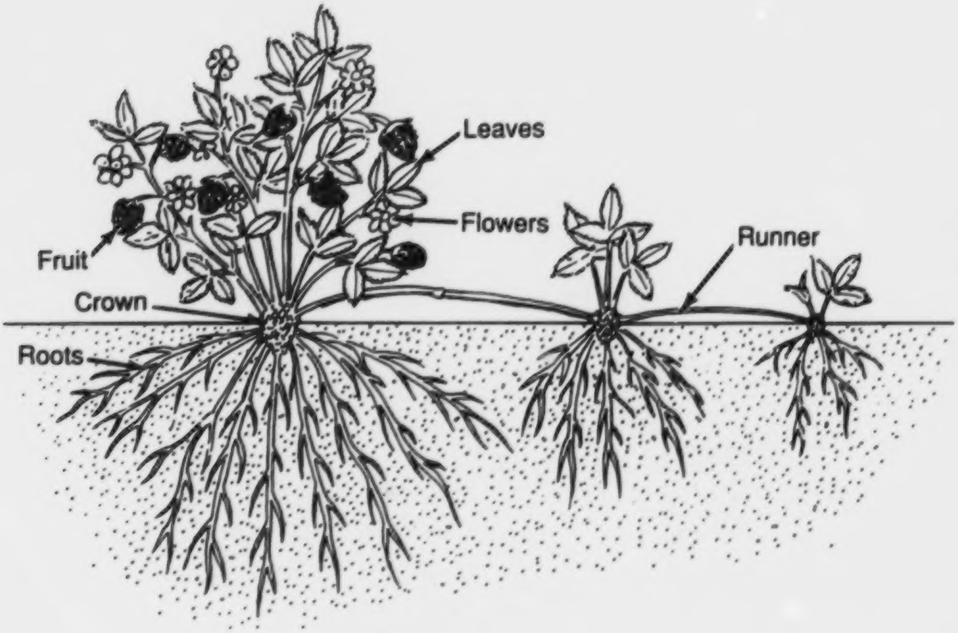
- **Crown** – The stem is a short and thickened structure from which the leaves and fruit arrangements are produced. The entire body of the plant is often referred to as the crown.

- **Runner** – The strawberry plant, throughout the summer after fruit production, sends out runners – or stolens. One plant can send out as many as ten runners with five new plants on each runner.

- **Roots** – The roots of the strawberry plant live from year to year although the leaves and top area die back in the fall where winter temperatures drop below freezing.

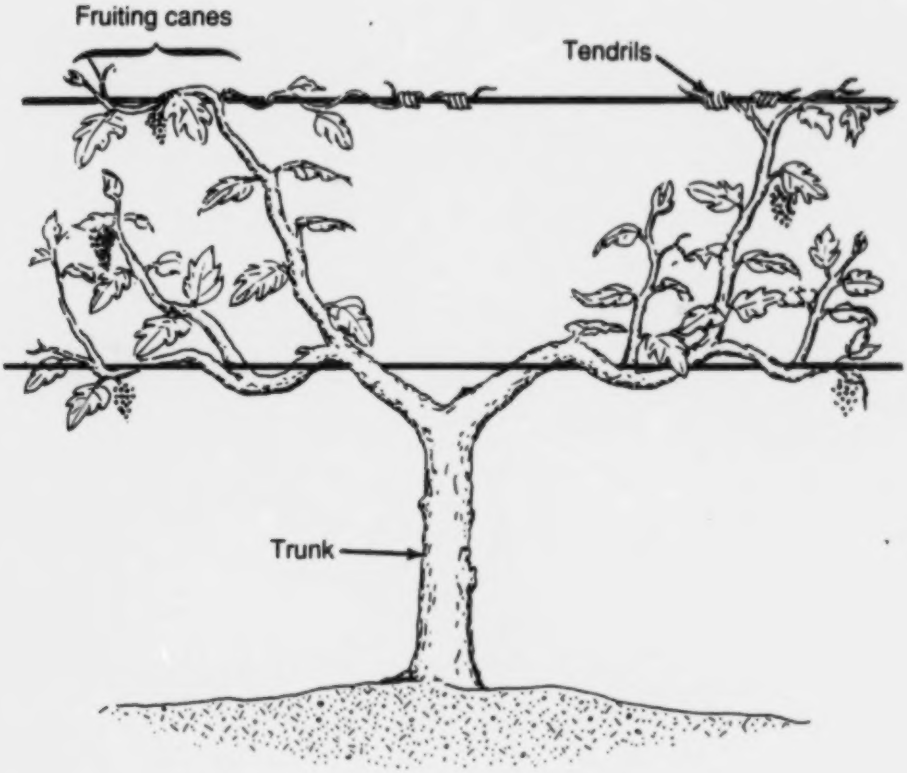
- **Flower** – The flowers occur in clusters with the primary flower ultimately becoming the largest strawberry.

- **Fruit** – The berry on the plant. Size is primarily determined by the variety, nutrition, and the number of pistils in the flower. The fruit size will generally decrease throughout the harvest season.



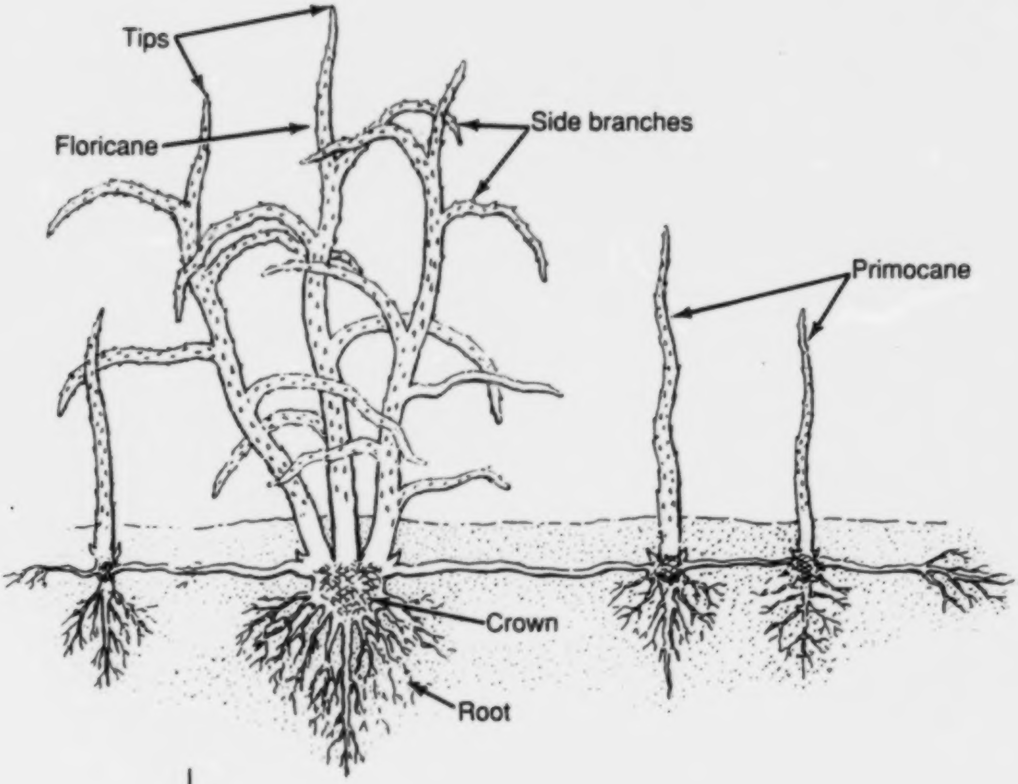
OBJECTIVE 6 **Identify parts of a llana.**

- **Cane** – The upright growth of the plant
- **Roots** – The roots of grapes are perennial
- **Laterals** – Side branches
- **Tendrils** – A modified stem found on certain vines, such as grape vines, that enable them to cling to objects or supports



OBJECTIVE 7 **Identify parts of a bramble.**

- **Primocanes** – New canes on a blackberry plant that are formed each season and produce flowers and fruit the following season
- **Floricanes** – Second season canes on a blackberry plant; die after fruiting (formerly primocanes)
- **Roots** – Are perennial; live year after year
- **Laterals** – Side branches
- **Crown** – The thickened structure above the roots from which the new canes arise
- **Tips** – The top part of the canes



OBJECTIVE 8

Describe the two types of dwarfed fruit and nut trees.

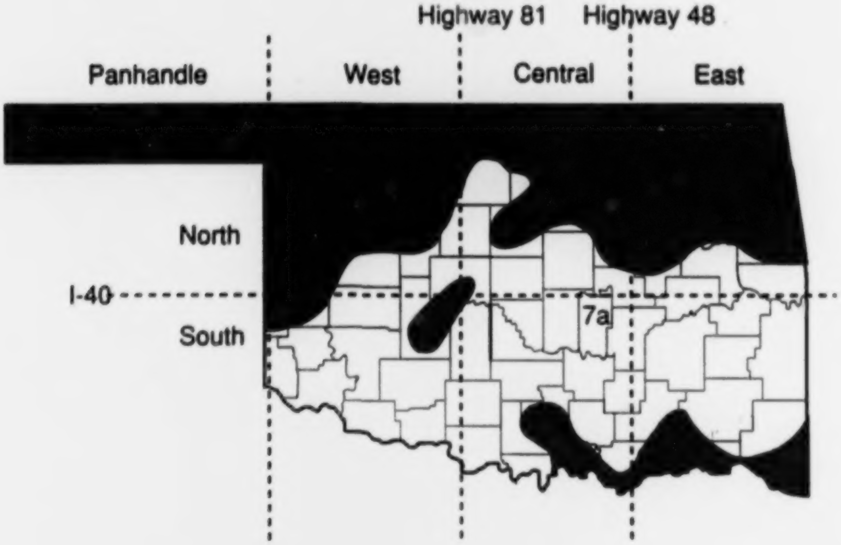
A dwarfed tree is one that is distinctly smaller than a standard-sized tree either because it is a genetic dwarf or a horticultural dwarf. In Oklahoma, apple trees are the most common dwarfed species.

- **Genetic dwarf** – Tree that is dwarfed naturally in nature

  EXAMPLE: Many varieties of apples

- **Horticultural dwarf** – Tree that is dwarfed through various horticultural practices such as pruning, root pruning, training, containerizing, or grafting

PLANT HARDINESS ZONE MAP



The USDA has recognized eleven climatic zones reaching from the Arctic Circle (1) in the north to Key West Florida (10) and Puerto Rico (11) in the south. Zone 6 and 7 divide Oklahoma somewhat diagonally. Starting from Zone 1 and moving southward, each zone is 10 degrees colder. In the illustration above,the "a" or northern portion of Zone 6 is five degrees colder than the "b" portion or southern portion of Zone 6.

These zones are referred to in plant catalogs and other reference materials. If a plant has a rating of 5/7, this means that the plant can tolerate the cold winter weather of Zone 5 as well as the summer heat of a Zone 7.

Courtesy of USDA

HOW BIG IS A FRUIT TREE?

by

Glenn "Cat" Taylor, Retired
Extension Horticulturist
Pecans and Tree Fruits
Oklahoma State University

A world renown horticulturist, Liberty H. Bailey, once asked an old gardener how much land he had, and the gardener replied with pride – "One acre." The old-timer added, "It is a wonderful acre; it reaches to the center of the earth in one direction, and it takes in the stars in the other."

This man's farm included not only the pot of gold at the end of the rainbow, but it contained the entire rainbow. Apparently, the size of an acre of land varies directly with the size of the man who manages it. a one-acre farm is considerably less in area than our average U.S. farm.

Likewise, many dwarf fruit trees are considerably smaller in stature than the normal or standard-size fruit tree.

Yet, with proper management, dwarf trees produce comparable size and quality fruit as standard, full-size trees.

Advantages claimed for dwarf trees are earlier bearing, greater convenience in spraying, pruning, and harvesting with per care yields commensurate with standard trees because of closer spacing and consequently more trees planted on a given area. From the home-garden standpoint, dwarf trees are better adapted to a restricted size area such as a backyard. If desired, a larger number of varieties can be planted in the same area.

In recent years, several terms have been associated with fruit trees to identify their ultimate size potential. Terms like dwarf, semi-dwarf, interstem, standard tree, and spur-type are examples. The following comments are aids to assist with clarification of dwarf fruit tree terms and selection of proper planting distances.

A. **Standard Trees** – Are developed by simply propagating the desired scion (variety) onto a seedling rootstock. These rootstocks, developed from seed, are considered vigorous and produce what is called a standard full-size tree.

B. **Dwarf Trees** – Are usually produced by three common methods:

1. Rootstocks – Impart the natural dwarfing tendency to the variety. From England, we have two common groups of dwarfing rootstock used for size control of apples; the Malling (M) and Malling Merton (MM). the chief difference between them is that the MM group is resistant to Wooly Apple Aphid. Generally, these rootstocks do not anchor and support the tree as well as common seedling stock.

2. Interstem – A typical interstem tree consists of a rootstock, one or more section of stem (trunk) pieces and the variety. Each tree section or place is genetically different. Here we have the advantage of using a strong, well-anchored rootstock, plus development of a small tree by inserting a dwarfing piece into the trunk. Additional trunk pieces may be added for trunk hardiness and trunk disease resistance.

3. Spur-Type – Varieties occasionally undergo genetic change, giving rise to mutations called "bud sports." Spur-type refers to selected apple sports with growth habits that produce longer limbs, fewer side branches, and more fruit spurs than the regular habit of growth (original variety). Thus, we have spur-type Golden Delicious and regular or standard-bearing Golden Delicious. Due to their habit of growth, spur-type trees are normally smaller than standard trees. A spur-type sport grafted or budded on a dwarfing rootstock is sometimes called a double-dwarf.

By far, more progress has been made with dwarf apples than other tree fruits.

Dwarf pears follow apples in popularity and acceptance by both home owner and commercial grower. Quince rootstock is generally used in producing dwarf pear trees.

Mature peach, nectarine, plum, apricot, and cherry trees are normally smaller than well-developed standard apple and pear trees. Trees of these stone fruits bear earlier and can be restricted in size easier by pruning that apple and pear. Therefore, there are fewer reasons for propagating stone fruits as dwarf trees.

The western sand cherry (Prumus besseyi) is commonly used as a dwarfing stock for these fruits; also, some of the native plum species are used to dwarf the peach.

The size of a fruit tree is also influenced by the following factors:

1. Selection of dwarfing rootstock or interstem – Some selections are more dwarfing than others. Length of interstem influences the degree of dwarfing. Longer interstem pieces are more dwarfing than shorter ones. Most are 3-12 inches long.

2. Some varieties are naturally more vigorous than others. For example, Delicious apple propagated on the same dwarfing rootstock as less vigorous Jonathan or McLemore varieties will occupy more tree space at maturity.

3. Pruning is a dwarfing practice and can produce a tree that occupies less space than an unpruned tree. Excessive pruning can reduce fruit production of mature trees and delay production of young trees.

4. Soils and planting sites – Trees on well-adapted, deep, well-drained, loamy-type soil grow to larger size and require wider spacing than trees on less desirable soils.

The following is a guide to determine proper tree spacing.

	Mature Tree Size*	Common Planting Distances (Feet)	No. Trees Required to Plant an Acre
Pear on Quince Rootstock	15%	6 to 10	1210 to 435
Malling IX Applestock	30%	8 to 12	680 to 302
Malling 26 Applestock	40%	10 to 14	435 to 222
Malling VII Applestock	50%	15 to 22	194 to 90
Peach, nectarine (standard)	50%	15 to 22	194 to 90
Plum (standard)	50%	15 to 22	194 to 90
Malling-Merton 106 Applestock	60%	16 to 24	169 to 75
Cherry (standard)	60%	16 to 24	169 to 75
Spur-type Apple on seedling rootstock	65%	18 to 26	134 to 64
Pear (standard)	70%	20 to 28	108 to 55
Malling-Merton III Applestock	70%	20 to 28	108 to 55
Seedling Apple	100%	30 to 40	48 to 27

*Approximate mature tree size expressed as percent of standard apple trees on seedling rootstock

The management system influences spacing. If a higher density planting such as a hedgerow is desired, closer spacing with corresponding greater tree population per acre should be figured.

Semi-dwarf, true dwarf, and semi-vigorous are terms often used to denote the amount of degree of dwarfing.

Fruit trees **come** in many sizes!!

Courtesy Oklahoma State University Agriculture Extension Service.

IDENTIFY FRUITS AND NUTS

ASSIGNMENT SHEET 1

Development of:
READING SKILLS
SOCIAL STUDIES SKILLS

- Introduce the assignment to the students by discussing why reading and social studies skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Using in-book references

  SOCIAL STUDIES

  - Interpreting maps/globes

- If students have difficulty using in-book reference tools:
  - Identify the content of the supplement and have students discuss how the information can be used to complete the assignment sheet.
  - Encourage students to use bookmarks or other devices to mark in-book references used most often.
  - Explain to students that books are "random access" tools, meaning the information in them is accessible in any order. Compare books to items which are not random access such as cassette tapes or video films.
  - Review terms used in the various references.
- If students have difficulty interpreting maps/globes:
  - Examine and define the various components of the map.
  - Discuss the purpose of the map.
  - Discuss the types of information that can be conveyed by a map.
  - Examine the orientation, legend and scale of the map.
  - Discuss the importance of being able to identify hardiness zones.

ASSIGNMENT SHEET 1

IDENTIFY FRUITS AND NUTS

Name ______________________ Score __________

INTRODUCTION

Because of the importance that temperatures play in crop production, the United States Department of Agriculture (USDA) has divided the United States and Canada into plant-hardiness zones. The zones are based on the approximate ranges of average, annual minimum temperatures. Knowing hardiness zones for your region will help in determining what kinds and varieties of fruits and nuts to select for planting.

DIRECTIONS

Use Supplement 1, Plant Hardiness Zone Map, and a map of Oklahoma to answer the following questions. Write your answers in the blanks provided.

Research and Reference Skills
- Use in-book reference tools

Information Analysis Skills
- Interpret maps/globes

1. What hardiness zones are found in Oklahoma?

   ____

2. Which of these zones is the mildest?

   ____

3. Apricots, nectarines and peaches are not normally recommended in Zones 2 to 5. Keeping this in mind:

   a. Should a grower in Goodwell, OK consider planting these fruits? ______________________________

      ____

   b. Should a grower in Tahlequah, OK consider planting these fruits? ______________________________

      ____

   c. Should a grower in Ardmore, OK consider planting these fruits? ______________________________

      ____

4. Using the following chart of varieties of apples and recommended hardiness zones, answer the questions below.

VARIETY	ZONES
Honeygold	3-5
Lodi	4-7
McIntosh	3-5
Macoun	4-6
Red Delicious	5-7
State Fair	3-5
American Beauty	5-7

a. Which varieties might a grower in Goodwell, OK select?

____

____

b. Which varieties might a grower in Bartlesville, OK select?

____

____

c. Which varieties might a grower in Duncan, OK select?

____

____

ASSIGNMENT SHEET 1

1. Zones 5, 6, and 7

2. Zone 7

3. a. no
   b. yes
   c. yes

4. a. Any of the varieties mentioned
   b. Lodi, Macoun, Red Delicious, American Beauty
   c. Lodi, Red Delicious, American Beauty

WRITTEN TEST

IDENTIFY FRUITS AND NUTS

I

Name ______________________ Score __________

OBJECTIVE 1

Match terms associated with fruits and nuts to their correct definitions. Write the letters of the correct answers in the blanks.

Part I

___ 1. A plant that lives more than two years

___ 2. Measure of the concentration of hydrogen ions in a soil or solution

___ 3. A ripened or mature ovary; the result of a fertilized flower. Also, the seed-bearing part of a plant

___ 4. The study of fruits; including cultivated tree fruits, nuts, grapes, and berries

___ 5. The lower parts of a grafted plant which provides the root system for the plant

___ 6. A plant that can grow along the ground or has tendrils that allow it to grasp or cling to walls or other support structures

a. pH
b. perennial
c. bareroot
d. entomology
e. pomology
f. rootstock
g. vine
h. creeper
i. fruit

May be photocopied for student use.

Part II

___ 1. A plant that keeps its foliage through the winter months

___ 2. A plant that loses its leaves during the fall

___ 3. A plant portion that is grafted or inserted into the rootstock and produces the fruit

___4. Woody vine

___5. Perennial plant that has a biennial growth and fruiting habit

___6. Plant that requires two seasons to complete its life cycle, the first for vegetative growth and the second to flower and fruit

a. scion

b. liana

c. fruit

d. deciduous

e. evergreen

f. annual

g. icon

h. biennial

i. bramble

OBJECTIVE 2 **Select from a list the main fruit types.** Write an "X" in the blank before each correct answer.

___ 1. Pome

___ 2. Grafted

___ 3. Vegetable

___ 4. Nut

___ 5. Stone

___ 6. Rock

___ 7. Multiple fruit

___ 8. Flowering fruit

___ 9. Small fruit

___ 10. Dwarf

May be photocopied for student use

OBJECTIVE 3 **Match fruit groups to their climatic requirements.** Write the correct letter in the blanks.

___ 1. Evergreen fruits, such as bananas and papayas

___ 2. Either deciduous or evergreen; these include citrus fruits

___ 3. Deciduous fruits; these include pome fruits, stone fruits, tree nuts, and berries

a. Arctic

b. Temperate

c. Inflorescence

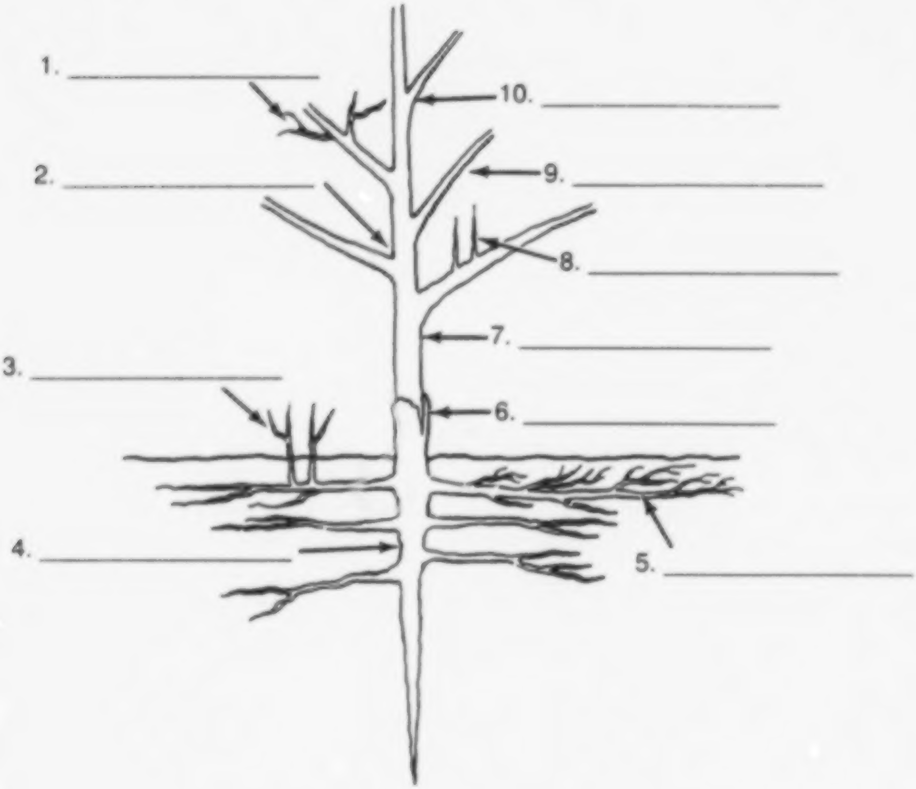
d. Tropical

e. Exotic

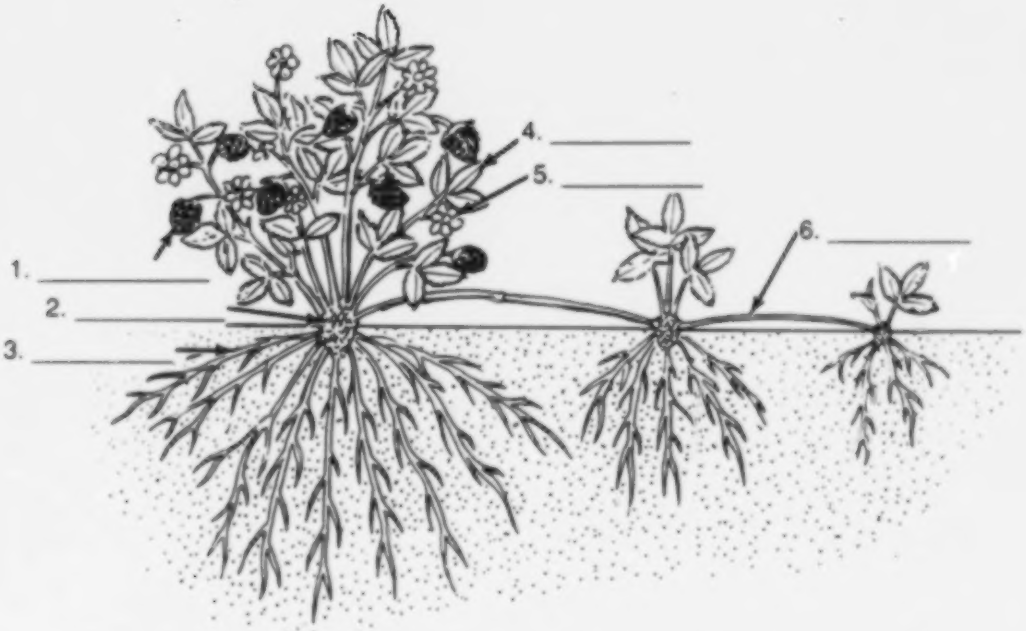
f. Mild

g. Subtropical

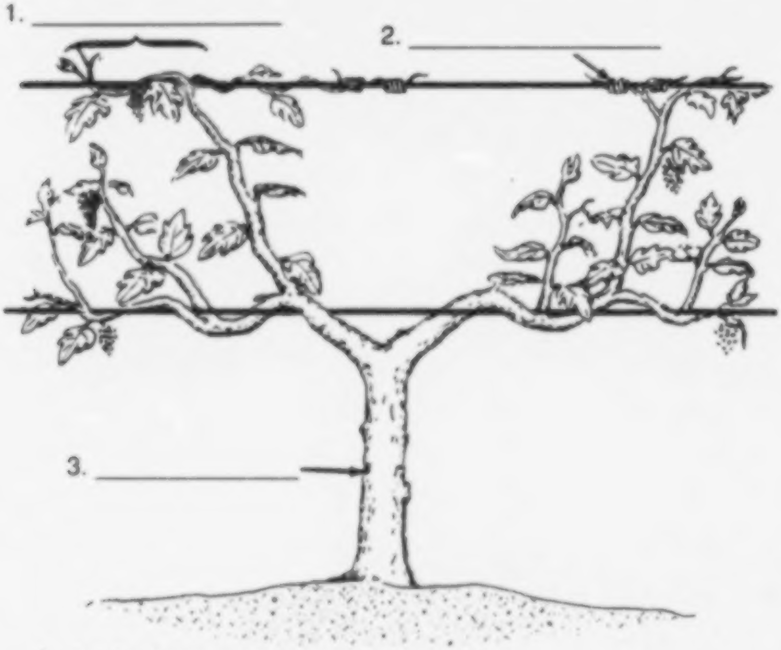
OBJECTIVE 4 **Identify parts of a tree.** Fill in each blank with the correct name of each part.



OBJECTIVE 5 **Identify parts of a strawberry plant.** Fill in each blank with the correct name of each part.



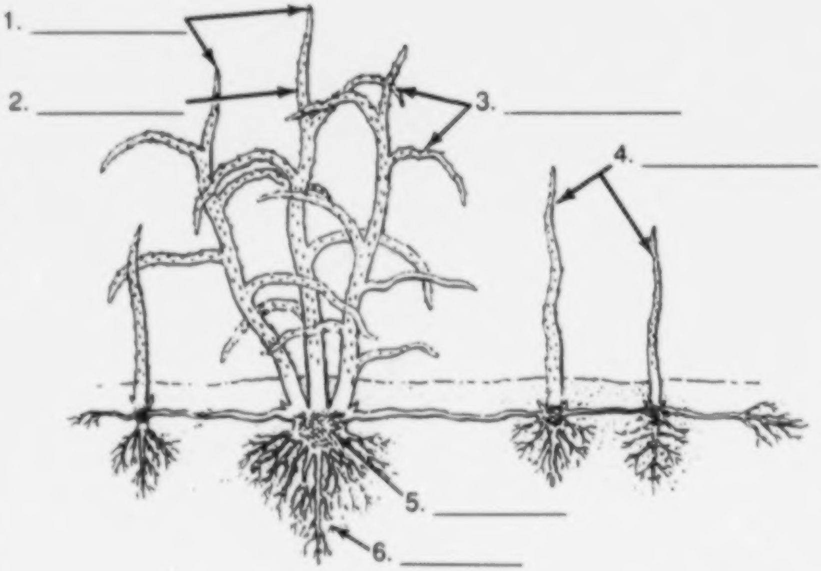
OBJECTIVE 6 **Identify parts of a llana.** Fill in each blank with the correct name of each part.



May be photocopied for student use.

OBJECTIVE 7

Identify parts of a bramble. Fill in each blank with the correct name of each part.



OBJECTIVE 8

Describe the two types of dwarfed fruit and nut trees. Write the definitions in the blanks provided.

1. Genetic dwarf – ______________________________

____

____

2. Horticultural dwarf – __________________________

____

____

NOTE: Objective 9 is evaluated on an assignment sheet in this unit. If you have not completed this component, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

IDENTIFY FRUITS AND NUTS

I

OBJECTIVE 1

Part I		Part II	
1.	b	1.	e
2.	a	2.	d
3.	i	3.	a
4.	e	4.	b
5.	f	5.	i
6.	g	6.	h

OBJECTIVE 2

1, 4, 5, 7, 9

OBJECTIVE 3

1. d
2. g
3. b

OBJECTIVE 4

1. Spur
2. Crotch
3. Sucker
4. Tap root
5. Feeder roots
6. Graft union
7. Trunk
8. Water sprouts
9. Scaffold
10. Central leader

OBJECTIVE 5

1. Fruit
2. Crown
3. Roots
4. Leaves
5. Flowers
6. Runner

OBJECTIVE 6

1. Fruiting canes
2. Tendrils
3. Trunk

OBJECTIVE 7

1. Tips
2. Floricane
3. Side branches
4. Primocane

OBJECTIVE 8

1. Genetic dwarf – Is dwarfed naturally.
2. Horticultural dwarf – Is dwarfed through various horticultural practices such as pruning, root pruning, training, containerizing, or grafting.

OBJECTIVE SHEET

SELECT A SITE FOR FRUIT AND NUT CROPS

II

INTRODUCTION

Selecting a site for fruit or nut crops is one of the most important decisions a grower must make. That is why it is crucial to know the factors to consider when picking a location. The location, in turn, will help determine the variety of fruit or nut to be planted. Anyone working in the fruit and nut industry should get to know local agricultural extension agents and other growers in the area to help make decisions on what and where to plant.

UNIT OBJECTIVE

After completing this unit, the student will be able to identify factors that affect site selection, describe types of orchard layout, list factors to consider when selecting rootstocks and determine suitable varieties of fruits and nuts for the Oklahoma area. The student will demonstrate these competencies by completing assignment sheets and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with selecting a site for fruit and nut production to their correct definitions.
2. Discuss factors affecting site selection for fruit and nut crops.
3. Describe soil factors affecting various fruit and nut crops.
4. Identify types of orchard layout.
5. List factors to consider when selecting root stocks or seedlings.
6. Describe tree characteristics that are important in the selection of pecan varieties.
7. Select from a list nut characteristics that are important in the selection of pecan varieties.
8. State the number of months or years required for fruits or grafted fruit trees to bear.
9. Select fruit varieties for your location using a planting guide. (Assignment Sheet 1)

10. Select nut varieties for your location using a planting guide. (Assignment Sheet 2)

SUGGESTED ACTIVITIES

SELECT A SITE FOR FRUIT AND NUT CROPS

II

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with selecting a site for fruit and nut production to their correct definitions.

Objective 2: Discuss factors affecting site selection for fruit and nut crops.

- Discuss terms used in this unit and, when possible, use examples to make the terms more meaningful to students. Show them what good sites for various crops look like; show them what poor sites look like and what happens as a result.
- Go over factors affecting site selection and, with students' help, analyze your particular area in terms of those factors.
- Give students a particular parcel of land in the state and have them analyze it according to the factors discussed in the Information Sheet.

Objective 3: Describe soil factors affecting various fruit and nut crops.

- Go over the soil characteristics that are important for various fruit and nut crops.
- Discuss soil samples and how they can help determine whether the soil is suitable, or can be corrected, for various corps.
- Review the various types of soil: loam, clay, silt, and sand. These are discussed in Unit XII, "Elementary Study of Soils," in CIMC's *Introduction to Horticulture*.
- Use OSU Fact Sheet NO. 6216, "Soils for Fruit Trees," to discuss soil requirements for fruit trees.
- Make sure students understand that not all sites will have "ideal" characteristics, but that there are ways to compensate for problems. For example, minerals can be added to change the pH of a soil; fertilizers can be added to improve the fertility of soils.

Objective 4: Identify types of orchard layout.

- Take students on a field trip to show them the various types of orchard layouts.
- Ask students to design an orchard layout and describe its good and bad qualities.

Objective 5: List factors to consider when selecting root stocks or seedlings.

- Explain to students the reasons most fruit and nut trees are started from rootstocks, not seed.
- Go over some of the suggested rootstock varieties for each type of fruit.
- Take students to an orchard to show them where the graft union is on the tree. If possible, show students a tree that has been grafted, and another tree of the same age, that has not been grafted.

Objective 6: Describe tree characteristics that are important in the selection of pecan varieties.

Objective 7: Select from a list nut characteristics that are important in the selection of pecan varieties.

- Use OSU Extension Fact Sheet NO. 6201, "Pecan Varieties for Oklahoma" to go over tree and nut characteristics that are important in selecting pecan varieties.
- Show students examples of nuts from different varieties of pecans. Have them explain the good and poor qualities of the nuts -- for example: small, thin shell, large kernel.
- Discuss fruits most susceptible to spring freezes.
- Discuss pollination needs.

Objective 8: State the number of months or years required for fruits or grafted fruit trees to bear.

- Discuss the time required for small fruits and grafted fruit and nut trees to bear fruit. Note that these times may vary depending on the variety of the fruit and the location.
- If you have a garden site, have students plant a berry crop (such as strawberries) and keep track of how long it takes the plant to bear fruit.

APPLICATION

Objective 9: Select fruit varieties for your location using a planting guide. (Assignment Sheet 1)

Objective 10: Select nut varieties for your location using a planting guide. (Assignment Sheet 2)

- Go over planting guides for your area and discuss some of the fruit and nut varieties popular among growers in your area.
- Have students use Supplements 1 and 2 to complete Assignment Sheets 1 and 2.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities if not previously done.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.
- Give the written test.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Obtain fruit and nut planting guides for your area from your county extension office or other source. Oklahoma residents can obtain *Home Fruit Planting Guide*, F-6222 and *Pecan varieties for Oklahoma*, F-6201, from their county extension office or order directly from Central Mailing Services, Oklahoma State University, Stillwater, OK 74078-0550.
- Dobbs, Steve and Glenn Taylor. *Home Fruit Planting Guide*. OSU Extension Facts Sheet No. F-6222. Cooperative Extension Service, Oklahoma State University: Stillwater, OK 74078-0550.
- Taylor, Glenn. *Pecan Varieties for Oklahoma*. OSU Extension Facts Sheet No. F-6201. Cooperative Extension Service, Oklahoma State University: Stillwater, OK 74078-0550.

UNIT REFERENCES

- Bishop, Douglas D., Lark P. Carter, Stephen R. Chapman, William F. Bennett. *Crop Science and Food Production.* Greg Division of McGraw-Hill Book Company: New York, NY, 1983.

- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications: Gainesville, FL, 1983.

- *Fruits and Berries.* The American Horticultural Society: Mount Vernon, VA, 1982.

- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Company: Houston, TX, 1978.

- *Pecan Production in the Southeast, A Guide for Growers* (Circular ANR-459)., Alabama Cooperative Extension Service: Auburn University, AL, 1989.

- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction: Des Moines, IA, 1982.

- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

INFORMATION SHEET

SELECT A SITE FOR FRUIT AND NUT CROPS

II

OBJECTIVE 1

Match terms associated with selecting a site for fruit and nut production to their correct definitions.

- **chilling hours** – number of hours of frost needed for certain fruit tree varieties to produce flowers, and thus bear fruit
- **hardiness** – ability of a plant or tree to withstand low temperatures
- **location** – proximity to population centers, transportation, marketing facilities, and labor pools
- **resistance** – ability of a plant or tree to fight off insects or diseases
- **site selection** – how well trees (or plants) will grow in relation to soil and elevation with respect to surroundings

OBJECTIVE 2

Discuss factors affecting site selection for fruit and nut crops.

- **Climate** – Temperature is the most important factor affecting the production of fruits and nuts in various regions. Extremely low temperatures can kill crops. However, most fruit trees require adequate winter chilling to produce flowers, and in turn, fruit. In addition, cool temperatures in the fall are needed to boost the quality of the fruit – for example, giving desired coloring to the skins of certain fruits. Wind and hail can also unfavorably impact the growth of fruits and nuts.
- **Elevation** – The elevation of an orchard site in relation to the surrounding terrain is more important than the total elevation (above sea level) of the region. A difference of 100 feet in elevation can make a difference of 5 to 10 degrees in the minimum temperature encountered.
- **Soil** – Fruit and nut orchards need soil with proper water drainage to allow for aeration and ample root development.

  NOTE: A soil survey map of your county can help by giving you an idea of the type of soil you have or where you should look for a deep, well-drained soil.

- **Slope** – There should be enough slope to allow adequate drainage of surface water. Very steep slopes should be avoided because of erosion hazard and difficulty in machine operations.

- **Moisture** – Fruit and nut crops need adequate moisture throughout the growing season. If rainfall cannot take care of those needs, then irrigation may be needed. Growers must also be sure that water is of good quality – not high in salt, for example.

- **Transportation and marketing facilities** – Growers need to be close to storage facilities, transportation, and local markets because fruits can perish quickly and are bulky to ship. Cost of transporting the produce is another consideration.

- **Labor** – Although machinery can aid in the production of fruit and nut crops, a lot of hand labor is still needed to get fruits and nuts to their final destination.

  NOTE: More information on labor concerns will be discussed in Unit XII.

OBJECTIVE 3 **Describe soil factors affecting various fruit and nut crops.**

Soil, as well as site, variety, and management, is important in obtaining high yields of quality fruits and nuts. Poor soil can reduce the size of yields by 50 to 100 percent within a relatively short period of time. Remember, the following are the most desirable soil characteristics and some fruits and nuts can tolerate less "perfect" conditions. For instance, some fruit trees will grow well in sandy soils if additional irrigation is used.

- **Soil texture** – The ideal soil would be a rather fertile sandy loam surface. Loamy soils allow water to penetrate fairly freely and also have good water holding capacity.

- **Soil depth** – The best soils for fruit and nut production are soils that have greater than 36" of soil for root development and 10 inches of surface soil.

- **Soil drainage and aeration** – Fruit and nut trees, small fruit plants, and vines will not tolerate wet soils during the growing season, especially in the spring when buds and shoots are developing. Well-drained soils with good aeration are usually identified by bright, uniform colors, sandy loam, silt loam, and clay loam for at least 48" of soil depth. Poorly drained soils favor root diseases.

NOTE: To check soil drainage, you can randomly dig some auger holes about 4 feet deep and observe the water table and drainage for several weeks – especially during the wet season. If water doesn't disappear in a day or two, avoid this area. Excessively drained soils usually don't store enough water to provide for proper growth and development of fruit trees.

- **Soil slope** – Soil slopes from 1 to 10 percent are suitable for growing fruit and nut crops. Very flat areas provide poor drainage. Areas with slopes greater than 10 percent may suffer from too much water runoff and soil erosion.
- **Soil reaction or fertility** – For most fruit trees, a pH of 5.8 to 6.5 is considered ideal, although they will tolerate a wider range, from 4.5 to 7.5. Soil fertility is not critical because fertilizer can be easily added even after the trees are planted. Blueberries require a pH of 5.0 to 5.5. Other small fruit crops favor a pH of 6.0 to 6.5.

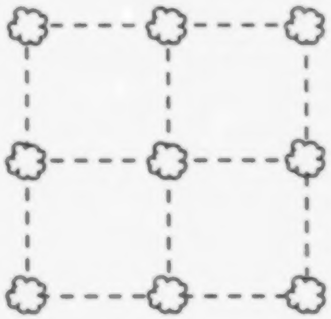
OBJECTIVE 4 **Identify types of orchard layout.**

Planning is highly important when plotting an orchard site since changes are difficult, and often costly, once the trees or crops are planted. Growers should put together a map outlining the layout of the trees, roadways, pipes, irrigation, drainage, pollinators, and other considerations.

Types of orchard layout:

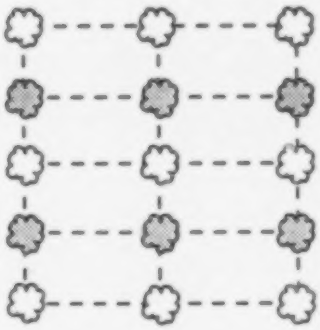
- **Square** – Trees are arranged in a square pattern. This is the most common planting arrangement.

SQUARE



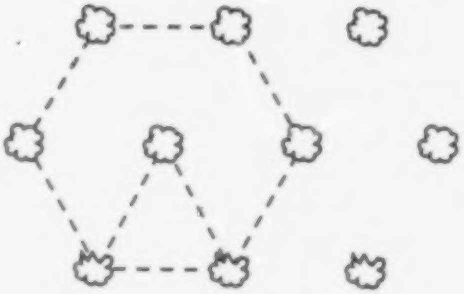
- **Rectangular (or hedgerow)** – Similar to the square layout, except additional trees are planted between trees in one direction. The additional trees are usually fillers that will be removed later.

RECTANGULAR



- **Hexagonal** (sometimes called triangular) – All trees are equal distance from each other, which makes efficient use of space. Growers should ensure enough room between mature trees since they are difficult to remove in later years. Growers can plant 15 percent more trees per acre than with square layout.

HEXAGONAL



OBJECTIVE 5

List factors to consider when selecting a rootstock.

Most fruit tree varieties are grafted or budded on seedling plants, called rootstocks, rather than grown from seed. Quality trees may not produce quality seeds.

- Select a variety that is resistant to disease, nematodes, insects, and other problems.

EXAMPLE: Grape rootstocks are used to get resistance to a root louse.

- Select varieties depending on type of soil (ie. sandy, clay). Some varieties do better in heavy, wet soils. Others favor sandy soils.

  EXAMPLE: Malling 7 apple (MM106) does better than others in heavier, wetter soils.

- Certain rootstock varieties have a dwarfing effect on other varieties. The choice of rootstock can, to a certain degree, determine the size of a mature plant or tree.

- The type of rootstock can determine the age of maturity of a tree as well as how long it will stay in production.

- Select a rootstock that will not compromise the quality of the fruit. Just because a variety is hardy, does not mean it is a good fruit-producer.

OBJECTIVE 6 **Describe tree characteristics that are important in the selection of pecan varieties.**

- **Fruiting habits** – The tree bears heavy annual crops.

- **Disease resistance** – The tree is resistant to scab and leaf diseases (although resistance can change with time).

- **Hardiness** – The tree remains relatively unaffected by low temperatures. Also, buds of some trees are less affected by cold temperatures.

  NOTE: There are two types of hardiness: spring frost hardiness and deep winter hardiness.

- **Growth habits** – The tree has large, dense foliage, retains its foliage until frost, and has good branching habits such as strong wood and wide-angled branches.

  EXAMPLE: The Cheyenne pecan has good branching, but not strong wood, so it is not a good variety to grow in windy areas.

OBJECTIVE 7 **Select from a list nut characteristics that are important in the selection of pecan varieties.**

- **Maturity** – The nut ripens before frost in the fall.

- **Size** – The nut is large enough for the shelling trade and for economical harvesting.

- **Shell** – The nut shell is brittle and thin enough to shell easily, but tough enough not to split during harvest.

- **Shelling quality** – The nuts yield 50 percent or more kernels; the kernel separates easily from the shell; and the nut produces a large percentage of whole kernels.

  NOTE: Football-shaped nuts crack best.

- **Kernel quality** – The kernel has a firm, plump, bright yellow color in addition to a good flavor and high oil content. It should also maintain quality during storage.

OBJECTIVE 8 **State the number of months or years required for small fruits or grafted fruit trees to bear.**

FRUIT CROP	APPROXIMATE TIME TO BEAR
Strawberries	(Fall planted) 6 months
Strawberries	(Spring planted) 14 months
Blackberries	2 years
Plums	2 years
Grapes	3 years
Peaches	3 years
Blueberries	4 years
Apples	4 years
Pears	5 years
Sour Cherries	5 years
Pecans	7 years

FRUIT PLANNING GUIDE

Kind	Suggested Varieties***	Season of Harvest *Central Oklahoma or adapted areas*	Remarks	Suggested Planting Distance In Feet	What to Buy	When to Plant
APPLES	*Lodi	June 28-July 6	Yellow, soft, cooking only.	Standard 25 to 30 or Semi-Standard 18 to 25 or Semi-dwarf 15 to 20 Spur-Types 15 to 22 or Dwarf 8 to 14	One year old trees	Fall or Spring
	*McLamore	July 10-July 25	Red, dessert and cooking			
	*Gala	Aug 10-20	Orange-red, dessert only.			
	*Jonathan	Aug 25-Sept 10	Red, dessert & cooking. Very susceptible to fireblight and cedar-apple rust.			
	*Delicious (red)	Sept 1-10	Red, dessert only.			
	*Golden Delicious	Sept 10-20	Yellow, dessert & cooking. Well adapted.			
	*Braeburn	Sept 10-20	Orangered blush over yellow, dessert and cooking			
	*Fuji	Sept 10-30	Yellow, dessert and cooking			
PEACHES	Candor	June 18-24	Yellow, semi-cling	20x20	June bud trees from the douth or dormant bud (one yr.) trees from the north	Fall or Spring
	Sentinel	June 28-July 3	Yellow, freestone			
	Redhaven	July 2-7	Yellow, freestone			
	Reliance	July 4-8	Yellow, freestone			
	Ranger	July 8-13	Yellow, freestone			
	Glohaven	July 15-20	Yellow, freestone			
	Nectar	July 15-20	Yellow, freestone			
	Jayhaven	July 21-27	Yellow, freestone			
	Cresthaven	July 28-Aug 3	Yellow, freestone			
	Autumnglo	Aug 6-10	Yellow, freestone			
	Ouachita Gold	Aug 13-17	Yellow, freestone			
	White Hale	Aug 13-17	Yellow, freestone			
	Starks Encore	Aug 20-25	Yellow, freestone			
	Fairtime	Sept 13-20	Yellow, freestone			
NECTARINES	EarliBlaze	July 3-9	Yellow, semi-freestone	20x20	June bud trees from the south or dormant bud (one yr.) trees from the north	Fall or Spring
	Redchief	July 15-20	White, freestone			
	Cavalier	July 21-27	Yellow, freestone			
	Sunglo	July 27-Aug 2	Yellow, freestone			
	RedGold	Aug 8-11	Yellow, freestone			
PLUMS (European)	Stanley	Aug. 20-Sept. 10	A prune plum, self-fruitful	20x20	One year old trees	Fall or Spring
	*Bluefre	Sept 1-15	Stanley x President cross			
	*President	Sept 10-20	Large, late ripening			
(Japanese)	*Methley	June 15-25	Red flesh, partly self-fruitful	20x20	One year old trees	Fall or Spring
	Bruce	June 15-25	Very productive, self-fruitful			
	*Ozark Premier	Aug. 10-20	Large, yellow flesh			
CHERRIES	Early Richmond	May 20-June 1	The standard of sour or pie cherry, very consistent	20x20	One or two year old trees	Fall or Spring
	*Kansas Sweet	May 22-June 5	Duke cherry (semi-sweet)			
	Montmorency	June 3-15	The standard of sour or pie cherry, very consistent			
	Northstar	June 5-20	Sour or pie			
	Meteor	June 5-20	Sour or pie (resistant to leaf spot)			
	Stella	June 5-20	Sweet (self-fertile)			
APRICOTS	Tilton	June 25-July 5	Commercial production should not be attempted	20x20	One year old trees	Fall or Spring
PEARS	*Moonglow	Aug 10-Aug 25	Fireblight resistant	25x25	One year old trees	Fall or Spring
	*Maxine	Aug 25-Sept 5	Fireblight resistant			
	**Magness	Sept 5-Sept 15	Fireblight resistant			
STRAWBERRIES	Earliglow	May 5-June 5	Incorporate organic matter ahead of planting strawberries; select virus indexed plants	2x4	One year old plants	Fall or Spring
	Sunrise	May 5-June 5				
	Atlas	May 10-June 10				
	Allstar	May 10-June 10				
	Cardinal	May 10-June 10				
	Delite	May 15-June 15				
	Marlate	May 15-June 15				

BEST COPY AVAILABLE

BLACKBERRIES	(Erect)					
	Choctaw	July 1-10	Very sweet	3x8	One year old root cuttings	Fall or early spring
	Womack	July 1-10	Very sweet			
	Cheyenne	July 10-30	Large very sweet			
	Cherokee	July 10-30	Medium large, very sweet			
	Shawnee	July 10-30	Latest ripening, high yields			
	Brazos	July 10-30	Good flavor. Southern Oklahoma only			
	(Erect Thornless)					
	Navaho	July 20-Aug 5	Sweet	3x8	One year old root cuttings	Fall or Spring
	(Trailing)					
	Boysen	July 10-30	Trellis or other support required	8x12	Tip layers	Early Spring
	Young	July 1-20				
	(Trailing Thornless)					
	Hull	July 20-Aug 5	Trellis or other support required	6x10	One year old plants	Fall or Spring
	Chester	July 20-Aug 5	Trellis or other support required			
GRAPES (Bunch)	Venus	July 15	Red, table-seedless	8x10	One or two	Spring
	Aurora (S 5279)	Aug 1	White, wine type			
	Seyval Blanc (SV 5276)	Aug 6	White, wine type			
	Villard Blanc (SV 12-375)	Aug 18	White, wine type			
	Rougeon (S 5898)	Aug 10	Blue, wine and juice			
	Delaware	Aug 15	Red, wine and table			
	Catawba	Sept 1	Red, wine and table			
	Verdelet (S 9110)	Aug 10	White, table			
	J.S. 18-104	Aug 1	Red, table			
	Romulus	Aug 20	White, table-seedless			
	Himrod	Aug 15	White, seedless			
	Fredonia	Aug 6	Blue, table and juice			
	Niagara	Aug 20	White, table and juice			
	Cimarron	Aug 15	Blue, juice			
	Carman	Aug 22	Blue, juice, for southwest Okla.			
	Rubaiyat	Aug 15	Blue, wine juice, jelly			
	Saturn	Aug 15	Red, table seedless			
	Reliance	Aug 15	Red, juice, jam, seedless			
	Mars	Aug 15	Blue, table, juice, jam, wine, seedless			
(Muscadine)	Adapted for McCurtain and Choctaw counties only. Variety information available upon request.			14x10	One year old vines	Fall or Spring
BLUEBERRIES	*(highbush)					
	Collins	June 5-June 19	Soil must be quite acid (pH 5.0). May require sulfur to change	4x8	12" to 18" well rooted plants	Early Spring
	Spartan	June 7-June 21				
	Blueray	June 12-June 26				
	Bluecrop	June 15-July 1				
	*(Rabbiteye)					
	Premier	July 6-July 19				
	Climax	July 10-July 30				
	Tifblue	July 20-Aug 3				
PERSIMMON (American)	Early Golden	September	For pollination, a male tree (pollen bearing) should be included in the planting or graft a male branch into a female tree	15 to 18	One or two year old trees	Spring
(Oriental)	Hachiya	November	Non-astringent when fully ripe	12 to 15	One or two year old trees	Spring
	Fuyugaki	November	Non-astringent			
	Tamopan	November	Astringent			
	Tanenashi	November	Astringent			
FIG	Ramsey (Texas Everbearing)	July to frost	For milder southern counties; have been grown in protected areas of Tulsa and Okla. City	8 to 10	One year old trees	Spring
	Brown Turkey	Aug. to frost				
JUJUBE (Chinese Date)	Lang	September	Used as sweet pickles, preserves, dried confections and fruit butter	18 to 20	One or two year old trees	Fall or Spring
	Li	September				
CRABAPPLES	Florence	August	Jelly and spice	20 to 25	one or two year old trees	Fall or Spring
	Dolgo	August	Jelly and spice			

*Needs cross pollinator. Those cultivars not marked with an asterisk are self-fertile.
**Pollen sterile
***Space does not permit listing of other satisfactory varieties. OSU Extension Fact Sheet #6210 contains additional recommended apple and peach varieties.

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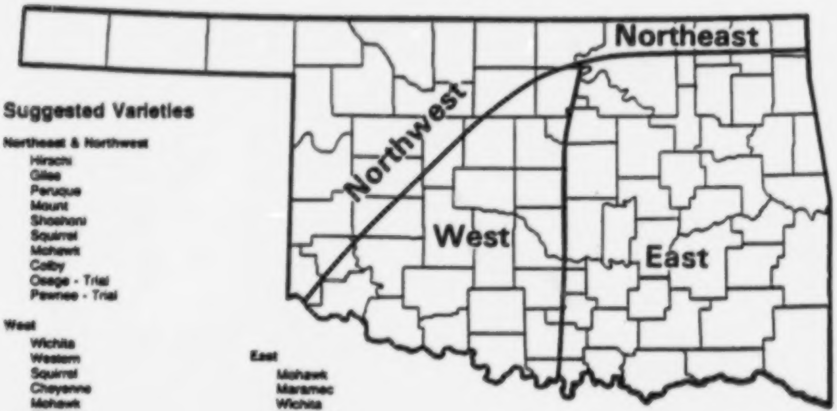
PECAN VARIETIES FOR OKLAHOMA



Suggested Varieties

Northeast & Northwest
- Hirschi
- Giles
- Peruque
- Mount
- Shoshoni
- Squirrel
- Mohawk
- Colby
- Osage - Trial
- Pawnee - Trial

West
- Wichita
- Western
- Squirrel
- Cheyenne
- Mohawk
- Shoshoni
- Shawnee
- Maramec
- Choctaw
- Graking
- Kiowa - Trial
- Sioux
- Oconee - Trial
- Houma - Trial
- Pawnee - Trial

(Choctaw, Graking, Kiowa - Trial, Sioux:) *Does best south of interstate 40*

East
- Mohawk
- Maramec
- Wichita
- Cheyenne
- Stuart
- Shoshoni
- Shawnee
- Graking
- Kiowa - Trial
- Choctaw
- Oconee - Trial
- Houma - Trial
- Pawnee - Trial

(Graking, Kiowa - Trial, Choctaw:) *Does best south of interstate 40*

Name	Avg. No. Nuts/lb.	Avg. Kernel %	Nut Maturity	Pollen Shedding	Scab Susceptibility	Origin	Parentage	No. Yrs. to Production*	Remarks
Southern Varieties									
CHEYENNE	56	59	Medium	Early	Moderate	Texas	Clark X Odom	5-6	Good shelter, bright kernel. Tree bears young and heavy. Limbs tend to split. Probably suited for temporary tree.
CHOCTAW	46	58	Late	Late	Low	Texas	Success X Mahan	7-9	Nuts blocky, attractive, thin shell. Tree resembles Success.
GRAKING	40	53	Late	Late	Low	Oklahoma	Seedling	7-8	Large, late maturing nut.
MARAMEC	45	58	Medium	Late	Moderate	Oklahoma	Mahan Seedling	7-8	Large, attractive, well-filled, high quality nut.
MOHAWK	37	57	Early to Medium	Late	Low	Texas	Success X Mahan	6-8	Nuts fill poorly on older trees. Well suited as a temporary tree for in-shell market.
SHAWNEE	55	60	Medium	Late	Moderate	Texas	Schley X Barton	7-9	Nuts are elongated. Kernels bright. Moderately productive.
SIOUX	68	59	Late	Late	High	Texas	Schley X Carmichael	6-8	Of highest quality for shelling.
SQUIRREL	54	57	Early	Early	Very High	Texas	Seedling	6-8	A consistent, productive variety when scab is controlled. Use only when sites have good air movement.
STUART	50	47	Medium	Late	Low	Mississippi	Seedling	10+	Nuts large, attractive, thick shell, flavor fair. Durable tree. Proven performance.
TEJAS	55	53	Medium	Late	High	Texas	Mahan X Risien #1	6-7	Tree extremely vigorous, good shelter.
WESTERN	58	55	Medium	Early	Very High	Texas	Seedling	6-7	Thin shell, fair quality. Repeatably high yields in western areas.
WICHITA	52	60	Medium	Late	Very High	Texas	Halbert X Mahan	5-7	Tree bears young and heavy. Susceptible to nut split and winter damage.

Northern Varieties

COLBY	62	45	Very Early	Late	Low	Illinois	Seedling	7-9	Consistent producer. Moderately productive.
HIRSCHI	70	49	Very Early	Early	Low	Missouri	Seedling	7-8	Trees are winter hardy. Consistent producer in northern areas.
GILES	72	51	Early	Early	Low	Kansas	Seedling	7-9	Moderately productive in northern Oklahoma. Nuts produce cold-hardy, growthy rootstock.
MOUNT	75	52	Early	Late	Low	Oklahoma	Seedling	7-8	Kernel separates freely from shell. Good producer.
PERUQUE	81	59	Very Early	Early	Low	Missouri	Seedling	7-9	Vulnerable to bird predation. Good shelling quality.

Newer Varieties Worthy of Trial Planting

KIOWA	46	57	Late	Late	Moderate	Texas	Mahan X Odom	6-8	Lacks winter hardiness. Promising for southern areas.
PAWNEE	50	58	Early to Medium	Early	Low to Moderate	Texas	Mohawk X Starking Hardy Giant	6-8	Promising early pollen shedder for all areas of Oklahoma.
OSAGE	85	54	Very Early	Early	Low	Texas	Major X Evers	6-8	Perhaps best suited for northern Oklahoma.
OCONEE	48	56	Early-Medium	Early	Moderate	Texas	Schley X Barton	5-7	High quality nut.
HOUMA	57	55	Late	Early	Low	Texas	Desirable X Curtis	6-8	Appears to be a steady performer.

*Years from planting of variety nursery tree until significant production [illegible] is expected.

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ASSIGNMENT SHEET 1

Development of:
READING SKILLS
SCIENCE SKILLS

- Introduce the assignment to the students by discussing why reading and science skills are important.

- Discuss with them the following skills which are relevant to this task:

  READING

  - Using in-book references
  - Interpreting graphics & symbols

  SCIENCE

  - Identifying/classifying living organisms

- If students have difficulty using in-book reference tools:

  - Discuss how to use charts and summaries. Identify the content of each and have students identify how each can be used for easy access to information.
  - Encourage students to use bookmarks or other devices to mark most-used in-book references.
  - Explain to students that books are "random access" tools, meaning the information in them is accessible in any order. Compare books to items which are not random access such as cassette tapes or video films.
  - Have students create their own in-book references by keeping word lists, glossaries, time lines, or lecture notes and relating each piece of information to its textbook location.
  - Display a variety of references and encourage students to begin to build their own reference library.

- If students have difficulty interpreting graphics and symbols:
  - Review the structure of the chart.
  - Create several hypothetical examples using the chart in a variety of applications.
  - Have them work with more proficient students to understand how to use these tables.
  - Have students create similar tables for handling and displaying information they are already familiar with.
- If students have difficulty identifying/classifying living organisms:
  - Review the specific characteristics of each species and variety listed in the planning guide.
  - Review definitions of characteristics such as "freestone" and "semi-cling".
  - Relate classification and characteristics to something they are already familiar with, such as cars, breeds of dogs, etc.
  - Review the use of an identification field guide and compare characteristics to those listed in the guide.

ASSIGNMENT SHEET 2

Development of:
READING SKILLS
MATHEMATICS SKILLS
SCIENCE SKILLS
SOCIAL STUDIES SKILLS

- Introduce the assignment to the students by discussing why reading, math, science, and social studies skills are important.
- Discuss with them the following skills which are relevant to this task:

READING

- Using in-book references
- Interpreting graphics & symbols

MATHEMATICS

- Interpreting charts & tables

SCIENCE

- Identifying/classifying living organisms

SOCIAL STUDIES

- Interpreting maps/globes

- If students have difficulty interpreting charts and tables:
  - Discuss with them the fact that the purpose of graphs is to represent numerical values in a visual form.
  - Review the structure of the chart.
  - Use simpler charts as models and demonstrate their use.
- If students have difficulty interpreting maps/globes:
  - Examine and define the various components of a map.
  - Discuss the purpose of the map.
  - Discuss the types of information that can be conveyed by a map.
  - Examine the orientation, legend and scale.
  - Have students compare the types of trees found in each region and discuss the critical characteristics of trees, geography, and climate that influence the differences and similarities.
- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheet 1.

ASSIGNMENT SHEET 1

SELECT A SITE FOR FRUIT AND NUT CROPS

II

Name ______________________________ Score ________

OBJECTIVE 9

Select fruit varieties for your location using a planting guide.

INTRODUCTION

As you have learned, the selection of fruit and nut crops for a particular location can hinge on many factors, one of the most important of which is climate. One of the best ways to determine the varieties of fruits that grow best in your area is to contact your local agricultural extension office.

DIRECTIONS

Use the planting guide in Supplement 1 to answer the following questions on suggested fruit varieties for your area.

Research and Reference
- Use in-book reference tools

Functional Reading Skills
- Interpret graphics & symbols

Life Science Skills
- Identify/classify living organisms

1. Which varieties of apple trees are considered to be cooking apple producers?
2. Which apple varieties are most desirable if you want to grow dessert apples?
3. If you wanted to grow yellow, semi-cling peaches which variety could you choose?
4. Which nectarine varieties are yellow, freestone?
5. Which nectarine variety is white, freestone?
6. Which plum variety is a prune plum?
7. Which plum variety is very productive and self-fruitful?
8. Which blackberry varieties require a trellis or other support?
9. Which variety of blackberry has good flavor, but is only suitable for Southern Oklahoma?
10. Which grape varieties are suitable for winemaking?
11. What type of soil is required for blueberries?
12. When planting strawberries, what age plants should you buy?

ASSIGNMENT SHEET 2

SELECT A SITE FOR FRUIT AND NUT CROPS

II

Name ________________________________ Score ________

OBJECTIVE 10 **Select nut varieties for your location using a planting guide.**

INTRODUCTION

According to agricultural researchers in Oklahoma, there are more than 200 named varieties of pecans grown in the United States. However, none have been completely satisfactory to Oklahoma growers, consumers, and shellers.

DIRECTIONS

Use Supplement 2 to answer the following questions.

1. Which pecan varieties have an average of 70 nuts per leaf or more?
2. Which varieties have high to very high scab susceptibility?
3. If you live in the Northeast or Northwest and want a variety with early or very early nut maturity, which might you select?
4. If you live in the West and want a pecan variety with late maturity, which would you select?
5. If you live in the West and are looking for a variety with low scab susceptibility, which would you choose?
6. Which of the suggested varieties for the West have an Oklahoma origin?
7. Which varieties suggested for the Northeast and Northwest have an Oklahoma origin?
8. Which of the suggested varieties for the East produces a tree that bears young and heavy but is susceptible to winter damage?
9. Which of the suggested varieties for the West has the highest quality for shelling?
10. Which of the suggested varieties for the East has large, attractive, well-filled, high quality nuts?

Research and Reference
- Use in-book reference tools

Functional Reading Skills
- Interpret graphics & symbols

Data Analysis and Display Skills
- Interpret charts & tables

Life Science Skills
- Identify/classify living organisms

Information Analysis Skills
- Interpret maps/globes

ASSIGNMENT ANSWERS

SELECT A SITE FOR FRUIT AND NUT CROPS

II

ASSIGNMENT SHEET 1

1. Lodi, McLemore, Jonathan, Golden Delicious, Braeburn, Fuji
2. McLemore, Gala, Jonathan, Red Delicious, Golden Delicious, Braeburn, Fuji
3. Candor
4. Cavalier, Sunglo, Red, Gold
5. Redchief
6. Stanley
7. Bruce
8. Boysen, Young, Hull, Chester
9. Brazos
10. Aurora, Seyval Blanc, Villard Blanc, Rougeon, Delaware, Catawba, Rubaiyat, Mars
11. Soil needs to be acidic (pH of 5.0)
12. One year old

ASSIGNMENT SHEET 2

1. Hirschi, Giles, Mount, Peruque, Osage
2. Sioux, Squirrel, Tejas, Western, Wichita
3. Hirschi, Giles, Peruque, Mount, Mohawk, Squirrel, Colby, Pawnee, Osage
4. Choctaw, Graking, Souix, Kiowa, Houma
5. Mohawk, Choctaw, Graking, Pawnee, Houma
6. Graking, Maramec
7. Mount
8. Wichita
9. Sioux
10. Maramec

WRITTEN TEST

SELECT A SITE FOR FRUIT AND NUT CROPS

II

OBJECTIVE 1

Match terms associated with selecting a site for fruit and nut production with their correct definitions. Write the letter of the correct answer in the blanks.

_____ 1. How well trees (or plants) will grow in relation to soil and elevation with respect to surroundings

_____ 2. Ability of a plant or tree to fight off insects or diseases

_____ 3. Proximity to population centers, transportation, marketing facilities, and labor pools

_____ 4. Ability of a plant or tree to withstand low temperatures

_____ 5. Number of hours of frost needed for certain fruit tree varieties to produce flowers, and thus, bear fruit

a. chilling hours

b. identification

c. climate

d. location

e. resistance

f. durability

g. site selection

h. freezing time

i. hardiness

OBJECTIVE 2

Discuss factors affecting site selection for fruit and nut crops. Write your answers in the blanks provided.

1. Climate ____

____

____

____

2. Elevation ____

____

____

____

3. Soil ______________________________

____

____

____

4. Slope ______________________________

____

____

____

5. Moisture ______________________________

____

____

____

6. Transportation and marketing facilities ______________

____

____

____

7. Labor ______________________________

____

____

____

OBJECTIVE 3 **Describe soil factors affecting various fruit and nut crops.** Write your answers in the blanks below.

Soil texture – ______________________________

____

____

Soil depth – ______________________________

____

____

Soil drainage and aeration – ______________________________

____

____

Soil slope – ______________________________

____

____

Soil reaction or fertility – ______________________________

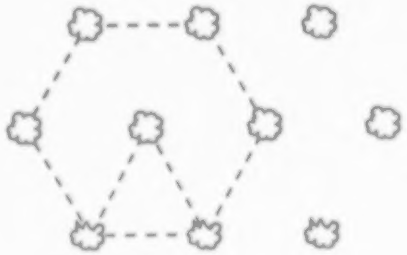
____

____

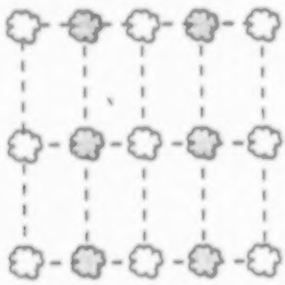
OBJECTIVE 4

Identify types of orchard layout. Write the correct names of the layouts in the blanks.

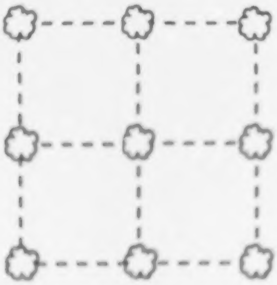
1. ______________________________



2. ______________________________



3. ______________________



OBJECTIVE 5

List factors to consider when selecting a rootstock. Write the characteristics and a brief description in the spaces provided below.

1. ____

____

2. ____

____

3. ____

____

4. ____

____

OBJECTIVE 6

Describe tree characteristics that are important in the selection of pecan varieties. Write your answers in the spaces provided.

Fruiting habits – ______________________________________

____

____

Disease resistance – ____________________________________

____

____

Hardiness –____

____

____

Growth habits –______________________________________

____

____

OBJECTIVE 7

Select from a list nut characteristics that are important in the selection of pecan varieties. Write a "T" in front of true statements and "F" in front of false statements.

___ 1. Nut ripens after frost in the fall.

___ 2. The kernel has a dark color.

___ 3. The kernel has high oil content.

___ 4. The nut is small for the shelling trade.

___ 5. The nut is large enough for economical harvesting.

___ 6. The nut shell is thin enough to shell easily, even if it splits during harvest.

___ 7. The nut produces a large percentage of whole kernels.

___ 8. The nuts yield 50 percent or more kernels.

OBJECTIVE 8

State the number of months or years required for small fruits or grafted fruit trees to bear. Write the months or years next to each fruit and nut crop.

_____ 1. Grapes

_____ 2. Strawberries (spring planted)

_____ 3. Blackberries

_____ 4. Apples

_____ 5. Plums

_____ 6. Blueberries

_____ 7. Pears

_____ 8. Pecans

_____ 9. Strawberries (fall planted)

_____ 10. Sour cherries

_____ 11. Peaches

NOTE: Objectives 9 and 10 are evaluated on assignment sheets in this unit. If you have not completed this component, see your instructor.

WRITTEN TEST ANSWERS

SELECT A SITE FOR FRUIT AND NUT CROPS

II

OBJECTIVE 1

1. g
2. e
3. d
4. i
5. a

OBJECTIVE 2

Answer should include the following:

1. Climate – Temperature is the most important factor affecting the production of fruits and nuts in various regions. Extremely low temperatures can kill crops. However, most fruit trees require adequate winter chilling to produce flowers, and in turn, fruit. In addition, cool temperatures in the fall are needed to boost the quality of the fruit – for example, giving desired coloring to the skins of certain fruits. Wind and hail can also unfavorably impact the growth of fruits and nuts.

2. Elevation – The elevation of an orchard site in relation to the surrounding terrain is more important that the total elevation (above sea level) of the region. A difference of 100 feet in elevation can make a difference of 5 to 10 degrees in minimum temperature encountered.

3. Soil – Fruit and nut orchards need soil with proper water drainage to allow for aeration and ample root development.

4. Slope – There should be enough slope to allow adequate drainage of surface water. Very steep slopes should be avoided because of erosion hazard and difficulty in machine operations.

5. Moisture – Fruit and nut crops need adequate moisture throughout the growing season. If rainfall cannot take care of those needs, then irrigation may be needed. Growers must also be sure that water is of good quality – not high in salt, for example.

6. Transportation and marketing facilities – Growers need to be close to storage facilities, transportation, and local markets because fruits can perish quickly and are bulky to ship. Cost of transporting the produce is another consideration.

7. Labor – Although machinery can aid in the production of fruit and nut crops, a lot of hand labor is still needed to get fruits and nuts to their final destination.

OBJECTIVE 3

Answers should include any four of the following:

Soil texture
Soil depth
Soil drainage and aeration
Soil slope
Soil reaction or fertility

OBJECTIVE 4

1. Hexagonal
2. Rectangular
3. Square

OBJECTIVE 5

Answer should include any four of the following:

1. Select a variety that is resistant to diseases, nematodes, insects and other problems.
2. Select varieties depending on type of soil (ie. sandy, clay). Some varieties do better in heavy, wet soils. Others favor sandy soils.
3. Certain rootstock varieties have a dwarfing effect on other varieties. The choice of rootstock can, to a certain degree, determine the size of a mature plant or tree.
4. The type of rootstock can determine the age of maturity of a tree as well as how long it will stay in production.
5. Select a rootstock that will not compromise the quality of the fruit. Just because a variety is hardy, does not mean it is a good fruit-producer.

OBJECTIVE 6

- Fruiting habits – The tree bears heavy annual crops.
- Disease resistance – The tree is resistant to scab and leaf diseases (although resistance can change with time).
- Hardiness – The tree remains relatively unaffected by low temperatures. Also, buds of some trees are less affected by cold temperatures.
- Growth habit – The tree has large, dense foliage, retains its foliage until frost, and has good branching habits such as strong wood, and wide-angled branches.

OBJECTIVE 7

1. F
2. F
3. T
4. F
5. T
6. F
7. T
8. T

OBJECTIVE 8

1. 3 years
2. 14 months
3. 2 years
4. 4 years
5. 2 years
6. 4 years
7. 5 years
8. 7 years
9. 6 months
10. 5 years
11. 3 years

OBJECTIVE SHEET

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

III

INTRODUCTION

Before planting an orchard, vineyard or berry crop, it is important to know what kind of soil is on the land, how to check for diseases, eradicate weeds, and get the area ready for planting. If you don't take care of these duties before planting, you could soon run into problems – such as an ineffective planting plan, or poorly producing trees and plants. **Planning** before planting can save you a lot of time and expense in the long run.

UNIT OBJECTIVE

After completing this unit, the student will be able to describe desirable soil characteristics for fruit and nut crops, list steps in soil preparations, know advantages and disadvantages of various orchard management programs, describe factors that affect tree and plant size, and be able to calculate the number of plants or trees needed per acre. The student will demonstrate these competencies by completing an assignment sheet and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with preparing a site for fruit and nut crops to their correct definitions.
2. Select from a list steps to prepare soil for planting.
3. Select from a list the reasons for establishing a soil management program.
4. Discuss advantages and disadvantages of the types of orchard soil management programs.
5. Identify tools and equipment used in soil preparation.
6. Match planting systems for strawberry plants to their correct description.
7. Match spacing requirements for grapes, blackberry, and blueberry plants.
8. Describe factors that affect the ultimate size of fruit and nut trees and berry plants.
9. Calculate the number of trees per acre in an orchard. (Assignment Sheet 1)

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply the guest speaker with the Objective Sheet, Information Sheet, and any other components you want them to cover.

- Obtain samples of various types of soil to show to the class.
- Obtain illustrations of various types of orchard layout.
- Obtain brochures of the various equipment used in orchard preparation.
- Decide how to administer the pretest and to whom.

DELIVERY

Objective 1: Match terms associated with preparing a site for fruit and nut crops to their correct definitions.

- Use the Information Sheet to discuss terms associated with preparing a site for fruit and nut crops. You may want to review some of the terms, such as pH, from previous units.

Objective 2: Select from a list steps to prepare soil for planting.

- Go over the steps identified in the Information Sheet. Emphasize that preparation should ideally be done from 1 to 5 years in advance.

- Test for soil drainage by digging or drilling a hole, as described in the information sheet, and checking how quickly water drains from the hole.

- Obtain a copy of a soil sample form from your local Cooperative Extension Service. As a class project, have students take a sample of soil from a nearby orchard or area that might be used for planting. Send the sample in for testing, and discuss the results when you receive them.

Objective 3: Select from a list the reasons for establishing a soil management program.

Objective 4: Discuss advantages and disadvantages of the types of orchard soil management programs.

- Show students illustrations of the various orchard soil management programs. Discuss which ones might be most appropriate for your area. If possible, take students on a field trip to show examples of the various systems.

Objective 5: Identify tools and equipment used in soil preparation.

- Show students photographs of various types of equipment or take them on a field trip to an equipment company so they can see the equipment first hand. Ask a representative from a farm equipment company to discuss the changes in orchard and vineyard equipment over the years.

- Have students call manufacturers to find out equipment costs and report back to the class.

Objective 6: Match planting systems for strawberry plants to their correct description.

Objective 7: Match spacing requirements for grapes, blackberry, and blueberry plants.

Objective 8: Describe factors that affect the ultimate size of fruit and nut trees and berry plants.

- Show examples of the types of planting systems for strawberry plants. Visit a local field, if possible. Discuss how equipment makes it easier to care for fields.

- Discuss the factors that affect spacing between trees and plants, and the recommended spacing requirements for grapes, blackberry and blueberry plants.

APPLICATION

Objective 9: Calculate the number of trees per acre in an orchard. (Assignment Sheet 1)

- Review the various types of orchard arrangements discussed in Unit II. Also, review factors that affect the size of trees and discuss how orchards can be thinned.

- Have students complete Assignment Sheet 1.

EVALUATION

Pretest

- Give written test as pretest.

- Determine individual study requirements from pretest results.

- Counsel students individually on pretest results and study requirements.

- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.

- Complete appropriate section of competency profiles.

- Reteach and reevaluate if necessary.

- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.

- Give the written test.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Taylor, Glenn. "*Planting and Early Care of the Peach Orchard.*" Fact Sheet No. 6244, Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.
- Dobbs, Stewart and Glenn Taylor. "*Soils for Fruit Trees.*" Fact Sheet No. 6216, Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.

UNIT REFERENCES

- Baudendistel, Robert F. *Horticulture: A Basic Awareness.* Reston Publishing Company, A Prentice-Hall Company: Reston, VA, 1979.
- Bishop, Douglas D., Lark P. Carter, Stephen R. Chapman, William F.Bennett. *Crop Science and Food Production.* Gregg Division, McGraw-Hill Book Company: New York, NY, 1983.
- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications: Gainesville, FL, 1983.
- Dobbs, Steven H. and Glenn Taylor. "*Soils for Fruit Trees.*" Fact Sheet No. 6216, Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.
- *Fruits and Berries,* The American Horticultural Society: Mount Vernon, VA, 1982.
- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Company: Houston, TX, 1978.

- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction, 1982.

- Reiley, Edward H., and Carroll L. Shry Jr. *Introductory Horticulture*, 3rd edition. Delmar Publishers Inc.: Albany, NY, 1988.

- Scheer, Arnold H. and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

- Taylor, Glenn. "*Planting and Early Care of the Peach Orchard.*" Fact Sheet No. 6244, Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.

INFORMATION SHEET

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

OBJECTIVE 1

Match terms associated with preparing a site for fruit and nut crops to their correct definitions.

- **complete sod culture** – the orchard is covered completely with sod
- **contact herbicide** – an herbicide that kills by directly applying it to a weed or plant
- **cover crops** – plants grown in fields or orchards to control weeds, prevent erosion, and improve the soil; also called sod
- **cultivation** – a type of soil management that requires regular discing of the orchard ground
- **noncultivation** – orchards are left flat or set up with permanent furrows or borders for irrigation; weeds are controlled with preemergence and contact herbicides
- **precociousness** – the ability of a plant or tree to produce at a young age
- **preemergence** – a chemical applied to an area in early spring to destroy weed seeds before they germinate
- **semi-sod culture** – a system of both chemical weed control and mowing of sod; herbicides are used in a flat strip or raised area in the tree row and row middles are mowed

OBJECTIVE 2

Select from a list steps to prepare soil for planting.

Remember, sometimes it is best to begin preparing your site as early as five years in advance to make sure the soil is free of pests and diseases. Soil amendments, such as those that may correct the soil pH, may need to be added well before planting.

- Check site for woody plants. If there have been woody plants located at the site within the past five years, there is a chance of damage from *Armillaria mellea*, a form of root rot (also called Oak root rot or Mushroom root rot). This rot can remain in the soil, surviving on wood pieces and roots, and then infect the roots of newly planted fruit trees. The five year period allows for complete decomposition of roots and pieces of wood.

- Take a soil sample of the field. County agricultural extension offices in Oklahoma, and most other states, offer a soil analysis for a nominal fee and give recommendations for additional nutrients or fertilizers based on that analysis.

- Apply nutrients or fertilizers as recommended, based on soil test results. This may include the addition of lime, magnesium, zinc, etc.

- Eradicate weeds. Cover crops can assist in the control of weeds. Winter rye and/or sudan grass can be planted the year before trees are planted to increase the amount of organic matter in the soil. However, make sure enough nitrogen is added for good growth. Perennial weeds (i.e. bermuda grass) will be much easier to control if you take care of them before, rather than after, planting.

- Subsoil the area. Many farm sites have an area of compacted soil 4-12 inches thick just below the depth of cultivation which can keep moisture from penetrating properly. Some farmers use a ripper-type machine to break up the compacted soil; they may subsoil anywhere from 20 inches deep to 5 or 6 feet deep, depending on the compaction.

- Sample the soil for nematodes. Fumigate the soil for nematodes or oak-root fungus, well in advance of planting. Fumigation should be done at least 30 days before planting.

- Determine whether to install an irrigation system. An underground system should be considered prior to planting.

OBJECTIVE 3

Select from a list the reasons for establishing a soil management program.

Soil management programs can assist the grower in producing a profitable crop. Soil management programs:

- Provide a good moisture supply for trees, particularly during the growing season
- Minimize or prevent soil erosion
- Increase or maintain the organic content of the soil
- Supply additional nutrients, if needed
- Control weeds
- Loosen soil for good aeration and water penetration

OBJECTIVE 4

Discuss advantages and disadvantages of the types of orchard soil management programs.

Each type of soil management program has advantages and disadvantages. Before selecting a program for your orchard, you should look carefully at the types of programs and the pros and cons of each.

- **Cultivation** – A type of soil management that requires regular discing of the orchard ground.

  Advantages:

  - Destroys weeds before they bloom.
  - Prepares the orchard for irrigation; bare, wet ground retains the most warmth during a frost.

  Disadvantages:

  - Soil may become compacted more readily than with other management systems; discing wet or very dry soils encourages compaction, which hinders water movement in the soil.
  - Cultivated orchards often become more dusty, and dustiness can increase pest problems.
  - Cultivation is an expensive system because it requires more orchard care and bigger equipment than other techniques.
  - Cultivated orchards are usually several degrees warmer than orchards managed by other methods; this can result in more sunburned fruit. In addition, cultivated orchards stay wet in the winter and spring, which hampers spraying and pruning.

- **Noncultivation** – Orchards are left flat or set up with permanent furrows or borders for irrigation. Weeds are controlled with preemergence and contact herbicides.

  Advantages:

  - Although initial costs of weed control and equipment may be high, this method becomes cheaper in following years because of only slight weed growth and no discing expense.
  - Bare ground stays warmer and can cut down possible frost damage.

Disadvantages:

- This method is suited only to flat or nearly flat ground where water penetrates evenly and there is no runoff.
- Surface sealing may occur after several years, meaning water will not seep evenly into the ground.
- Warmer soil may lead to more sunburned fruit.

- **Semi-sod culture** – This program uses both chemical weed control and mowing of sod; herbicides are used in a flat strip or raised area in the tree row and row middles are mowed.

Advantages:

- It is relatively inexpensive and efficient because orchard operations are done only in one direction.
- Sodded middles improve water penetration and, in wet periods, give better footing for equipment.
- Sod remains fairly cool during warm weather and helps control pests such as mites.

Disadvantages:

- Sod does not retain heat so flowers may be endangered by spring frosts.
- This system requires more water (15 to 30 percent) and more nitrogen per acre to satisfy the needs of the trees and sod.

- **Complete sod culture** – The orchard is covered completely with sod.

Advantages:

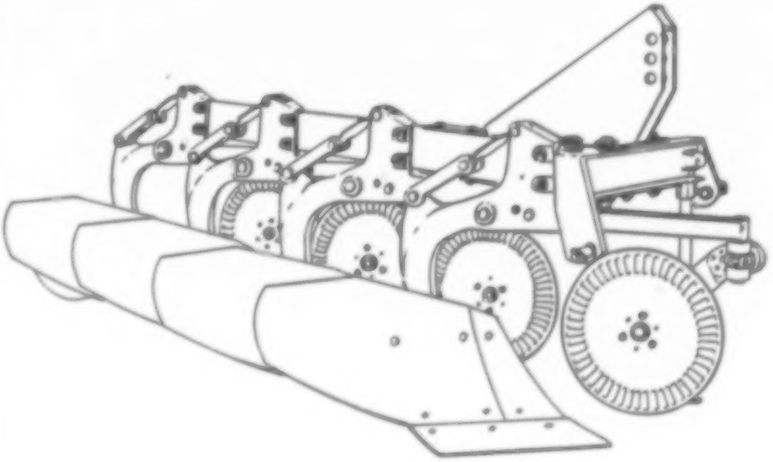
- This method is more suitable for uneven land, such as hillsides where erosion can be a problem.
- It is relatively inexpensive and efficient because orchard operations are done only in one direction.
- Sodded middles improve water penetration and, in wet periods, give better footing for equipment.
- Sod remains fairly cool during warm weather and helps control pests such as mites.

Disadvantages:

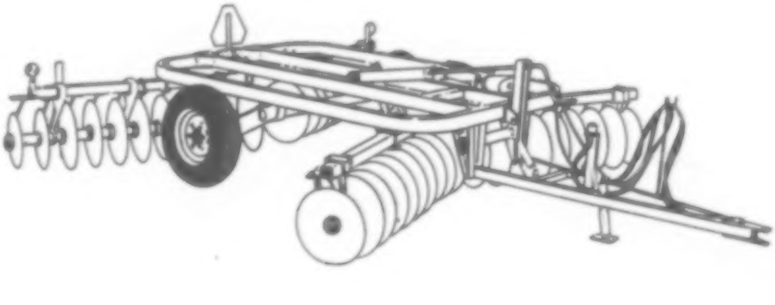
- Sod does not retain heat so flowers may be endangered by spring frosts.
- This system requires more water (15 to 30 percent) and more notrogen per acre to satisfy the needs of the trees and sod.

OBJECTIVE 5 **Identify tools and equipment used in soil preparation.**

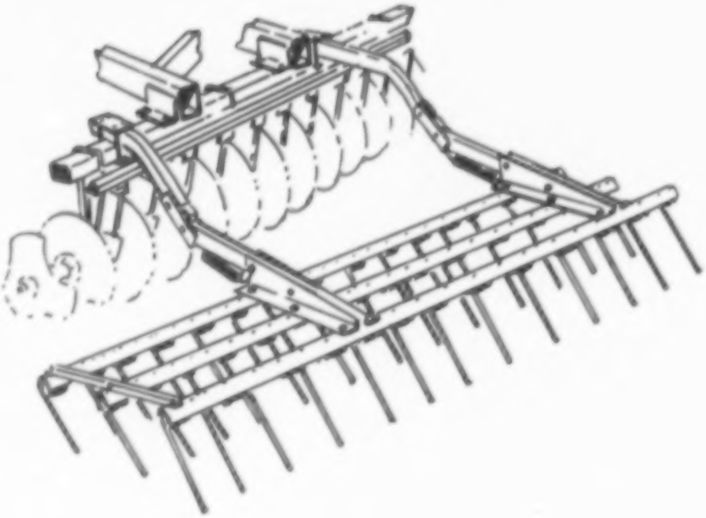
- **Plow** – Farm or orchard equipment used to cut, turn up, and break up the soil



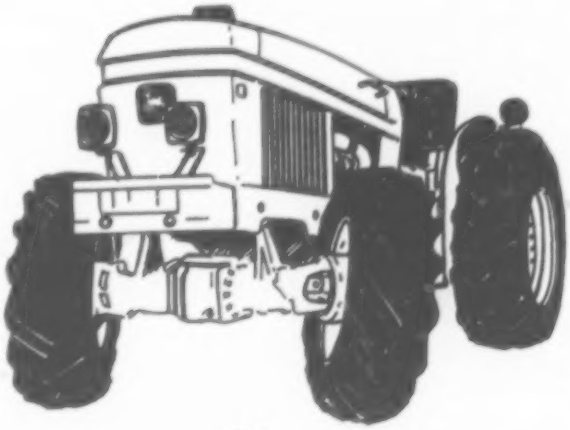
- **Disc** – Farm equipment with circular, sharp blades used to break up land or smooth areas that have already been plowed



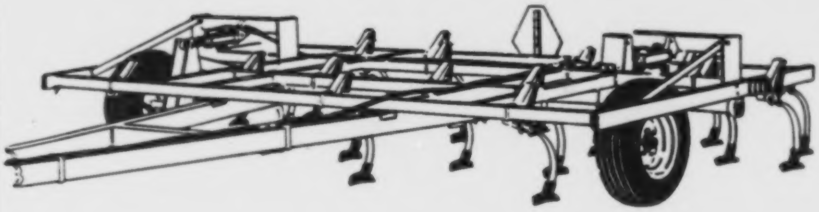
- **Harrow or disc harrow** – Farm machinery equipped with either tines or discs used to break up clods and create a smooth planting surface



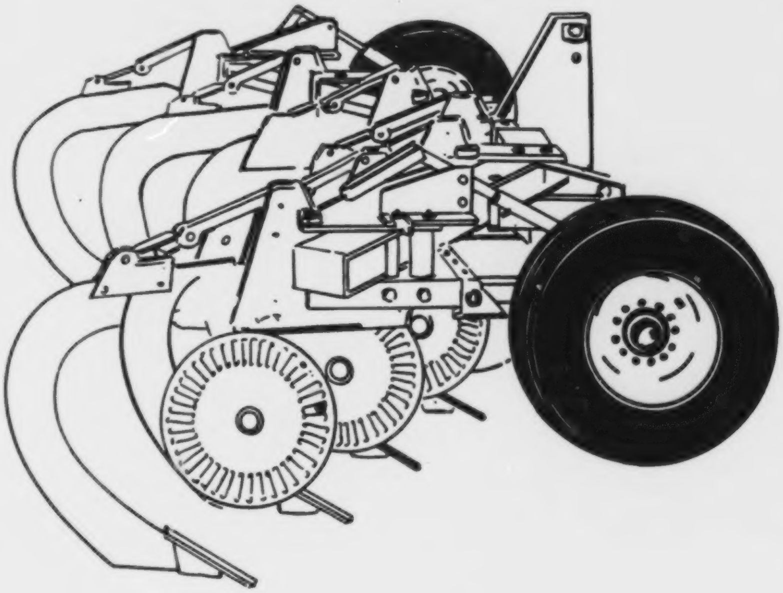
- **Tractor** – Motorized farm equipment with huge rear wheels or a continuous tread rolling over cogged wheels, used for pulling farm machinery, hauling loads, etc.



- **Cultivator** – Farm machinery equipped with tines or spikes used to smooth the soil or help spread chemicals uniformly



- **Subsoiler or ripper** – A ripper-type machine used to break up compacted soil; used when subsoiling



OBJECTIVE 6

Match planting systems for strawberry plants to their correct description.

- **Hill system** – No runners are allowed to grow. Plants are planted in double rows; plants are about 10-12 inches apart and rows are 12 inches apart. There is a 25 inch area separating the double rows.
- **Matted row system** – Some or all runners are allowed to grow to fill in the rows. Plants are placed 18 to 24 inches apart with a 42-inch space between rows.

OBJECTIVE 7

Match spacing requirements for grapes, blackberry and blueberry plants.

- **Grapes** – Plants are placed 8 to 10 feet apart; rows are 10-12 feet apart
- **Blackberries** – Plants are placed 2-3 feet apart; rows are at least 12 feet apart
- **Blueberries** – Plants are placed 4-6 feet apart; rows are 8-10 feet apart

NOTE: Remember that spacing will depend on the variety of fruit or berry.

OBJECTIVE 8

Describe factors that affect the ultimate size of fruit and nut trees and berry plants.

Remember, these factors will, in turn, affect the amount of spacing between trees or plants.

- **Rootstocks** – Some rootstocks may be dwarfing, thus reducing the size of trees.
- **Inherent vigor of variety** – Some varieties are more vigorous than others and will get larger.
- **Soil fertility** – More fertile soil will increase the size of trees and plants.
- **Climate and site** – Length of growing season, sunlight, severity of weather, moisture, will affect size.
- **Pruning** – Pruning can reduce the size of trees, but can also cause greater growth in the immediate vicinity of the cut, depending on when and how it is done.
- **Amount of fruit set** – The more fruit the tree or plant bears, the less the growth.

ASSIGNMENT SHEET 1

Development of:
MATHEMATICS SKILLS

- Introduce the assignment to the students by discussing why mathematics skills are important.

- Discuss with them the following skills which are relevant to this task:

  MATHEMATICS

- Rounding off numbers

- Calculating with whole numbers

- Solving word problems

- Selecting/applying mathematical procedure

- Solving practical problems

- If students have difficulty rounding off numbers, review the basic skills for rounding off numbers.

  EXAMPLE: If a decimal number is 5 or more, change the digit to its left to the next higher number. If the number is 4 or less leave the number to the left as it is.

- If students have difficulty calculating with whole numbers:

  – Review basic skills in addition, subtraction, multiplication, and division.

  – Review mathematical terminology.

    EXAMPLE: A "square foot" is a measure of area, determined by multiplying L x W.

- If students have difficulty solving word problems or with solving practical problems:
    - Instruct students to find the key elements of the problem.
    - Instruct students to identify each piece of given information.
- If students have difficulty selecting and applying math procedures:
    - Instruct the students to reword the problem in a form that is clearer to them.
    - Review the mathematical procedures that are relevant to this assignment.
    - Review mathematical terminology.
- If students have difficulty solving practical problems:
    - Discuss the importance of having this skill and information to producing a fruit and nut crop.
    - Have students discuss the consequences of NOT knowing how to calculate the number of trees per acre in an orchard.
    - Discuss other applications of being able to perform these calculations and related problems of proportion and ratio and their importance to today's society.

ASSIGNMENT SHEET 1

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

III

Name ______________________________ Score __________

OBJECTIVE 9

Calculate the number of trees per acre in an orchard.

INTRODUCTION

The use of more machinery in the fields is making its impact on orchard layout. Now, more trees are planted closer together in rows, but the rows are farther apart to make room for equipment that helps with spraying, pruning, and harvesting. Remember to make allowances for this large equipment, particularly when making turns in the orchard.

In addition, you may want to consider the variety of fruits or nuts you are planting. Some cultivars are naturally small and do not need as much growing room as others. Also, those trees or vines planted in good soils should be farther apart than those in poorer soils.

To determine the number of trees or plants per acre:

1. Take the space (in feet) between the rows of trees: i.e. 4 feet.
2. Multiply by the space (in feet) between the trees in the row: i.e. 6 feet.
3. Divide into the square feet in an acre: 43,560.
   or: 43,560 divided by 24 equals 1,815 trees per acre

DIRECTIONS

Below are some of the typical planting distances for various fruit crops. Determine how many trees or vines per acre you will need to plant. Round off your answers and write them in the blanks provided.

1. You are planting a nectarine orchard and have determined that there should be 18 feet between the rows and 18 feet between the trees. How many trees per acre will you plant? __________

Operation and Calculation Skills
- Round off numbers
- Calculate with whole numbers

Math Applications Skills
- Solve word problems
- Select/apply mathematical procedure

Functional Math Skills
- Solve practical problems

2. You are planting a pear orchard and have determined that there should be 20 feet between the rows and 20 feet between the trees. How many trees per acre will you plant?

   ____

3. You are planting a peach orchard and have determined there should be 24 feet between the rows and 18 feet between the trees. How many trees per acre will you plant?

   ____

4. You are planting an apple orchard and determine that you will allow 25 feet between the rows and 25 feet between the trees. How many trees per acre will you plant?

   ____

5. You are planting a pecan orchard and determine that you will allow 40 feet between the rows and 40 feet between the trees. How many trees per acre will you plant?

   ____

6. You are planting a vineyard and determine that you will allow 8 feet between the vines and 12 feet between the rows. How many vines per acre will you plant?

   ____

ASSIGNMENT ANSWERS

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

III

ASSIGNMENT SHEET 1

1. 134
2. 109
3. 101
4. 70
5. 27
6. 454

WRITTEN TEST

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

III

Name ______________________________ Score ____________

OBJECTIVE 1

Match terms associated with the preparing a site for fruit and nut crops to their correct definitions. Write the letter of the correct answer in the blanks.

___ 1. Orchards are left flat or set up with permanent furrows or borders for irrigation; weeds are controlled with preemergence and contact herbicides

___ 2. Type of soil management that requires regular discing of the orchard ground

___ 3. Chemical applied to an area in early spring to destroy weed seeds before they germinate

___ 4. Orchard is covered completely with sod

___ 5. Herbicide that kills by directly applying it to a weed or plant

___ 6. Ability of a plant or tree to produce at a young age

___ 7. System of both chemical weed control and mowing of sod; herbicides are used in a flat strip or raised area in the tree row and row middles are mowed

___ 8. Plants grown in fields or orchards to control weeds, prevent erosion, and improve the soil; also called sod

a. preemergence

b. noncultivation

c. discing

d. semi-sod culture

e. complete herbicide

f. vigorous

g. precociousness

h. complete sod culture

i. mowing

j. cultivation

k. contact herbicide

l. hardpan

m. cover crops

May be photocopied for student use.

OBJECTIVE 2 **Select from a list steps to prepare soil for planting.** Place an "X" in the blank before each correct answer.

___ 1. Plant smaller trees or plants to give them time to grow.

___ 2. Sample the soil for nematodes and fumigate for nematodes or oak-root fungus.

___ 3. Determine whether to install an irrigation system.

___ 4. Check site for woody plants.

___ 5. Water area thoroughly to allow native plants to grow.

___ 6. Do NOT apply nutrients or fertilizers until after planting.

___ 7. Eradicate weeds.

___ 8. Take a soil sample of the field.

___ 9. Remove topsoil.

___ 10. Subsoil the area.

OBJECTIVE 3 **Select from a list the reasons for establishing a soil management program.** Place an "X" in the blank in front of each correct answer.

___ 1. Increase or maintain the organic content of the soil

___ 2. Supply additional nutrients, if needed

___ 3. To ensure proper spacing between trees and rows

___ 4. Control weeds

___ 5. Allow soil to erode

___ 6. Provide a good moisture supply for trees

___ 7. Ensure no orchard maintenance in future years

___ 8. Loosen soil for good aeration and water penetration

May be photocopied for student use.

OBJECTIVE 4

Discuss advantages and disadvantages of the types of orchard soil management programs. Write one advantage and one disadvantage for each type in the space provided.

1. **Cultivation** –

   Advantage: ______________________________

   ____

   Disadvantage: ______________________________

   ____

2. **Noncultivation** –

   Advantage: ______________________________

   ____

   Disadvantage: ______________________________

   ____

3. **Semi-sod culture** –

   Advantage: ______________________________

   ____

   Disadvantage: ______________________________

   ____

4. **Complete sod culture** –

   Advantage: ______________________________

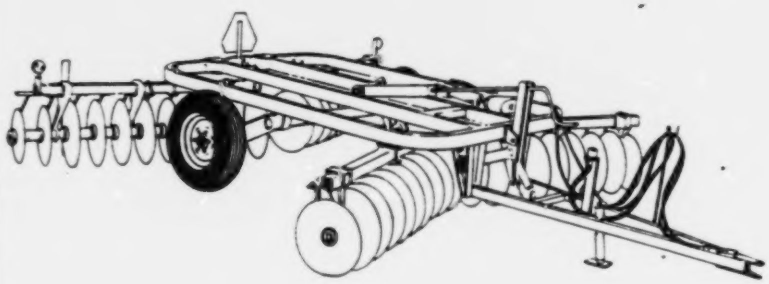
   ____

   Disadvantage: ______________________________

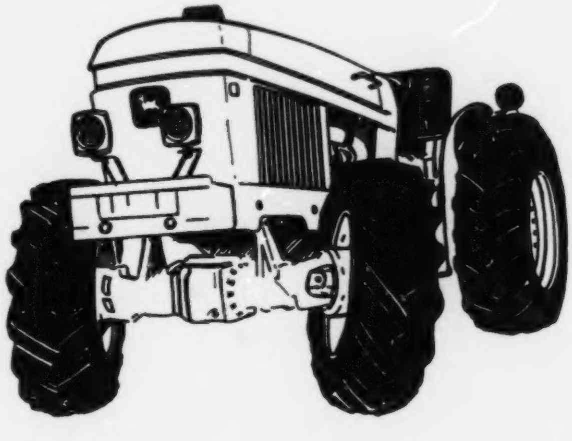
   ____

May be photocopied for student use.

OBJECTIVE 5 **Identify tools and equipment used in soil preparation**. Write the correct name of the equipment in the blanks.



1. ______________________



2. ______________________

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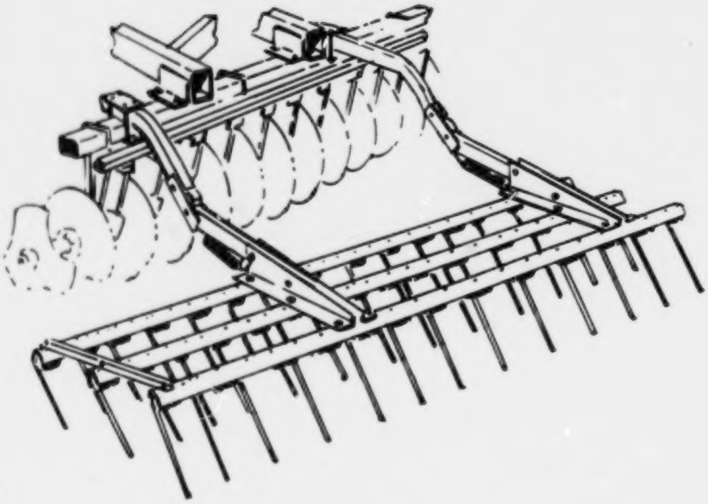
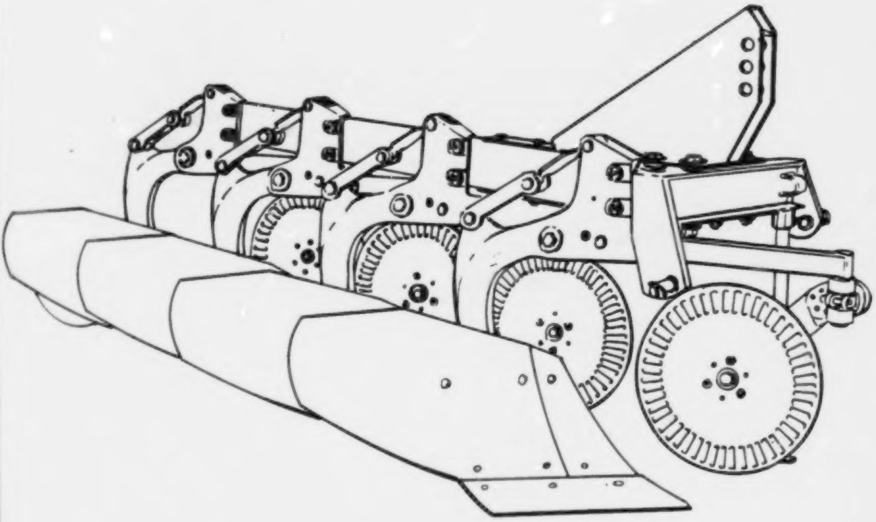


3. ______________________



4. ______________________

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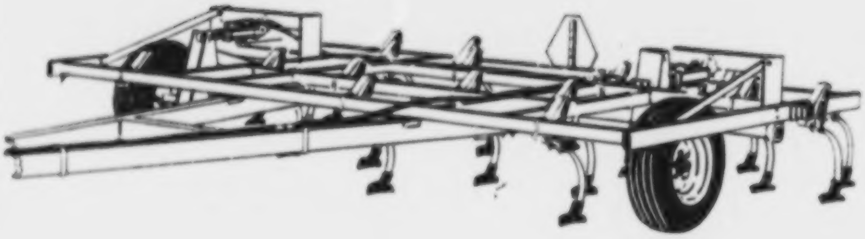
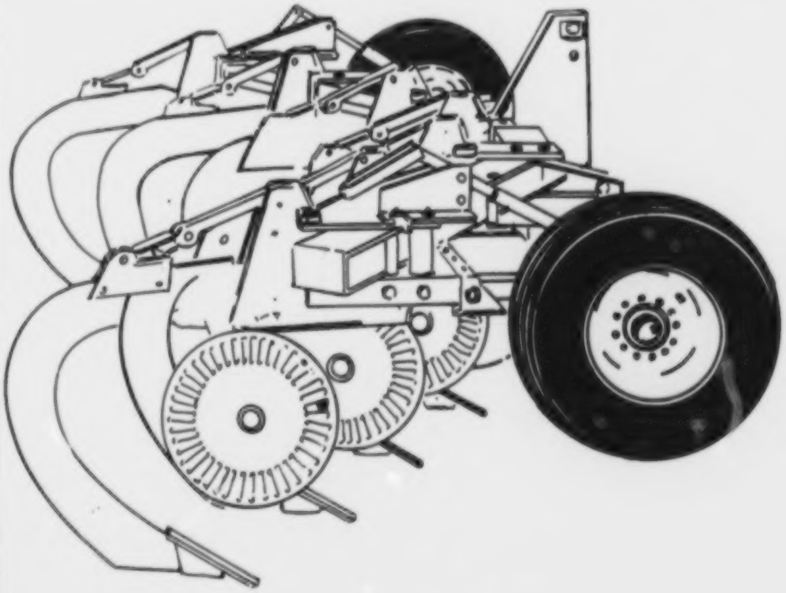


5. ______________________



6. ______________________

May be photocopied for student use.

OBJECTIVE 6

Match planting systems for strawberry plants to their correct description. Write the letter of the correct answer in the blank.

_____ 1. No runners are allowed to grow. Plants are planted in double rows; plants are about 10-12 inches apart and rows are 12 inches apart. There is a 25 inch area separating the double rows.

_____ 2. Some or all runners are allowed to grow to fill in the rows. Plants are placed 18 to 24 inches apart with a 42-inch space between rows.

a. hedgerow

b. hill system

c. trellace

d. matted row system

OBJECTIVE 7

Match spacing requirements for grapes, blackberry and blueberry plants. Write the letter of the correct answer in the blank.

_____ 1. Grapes

_____ 2. Blackberries

_____ 3. Blueberries

a. Plants are placed 4-6 feet apart; rows are 8-10 feet apart

b. Plants are placed 1 to 2 feet apart; rows are 3 to 4 feet apart

c. Plants are placed 2 to 3 feet apart; rows are at least 12 feet apart

d. Plants are placed 8 to 10 feet apart; rows are 10 to 12 feet apart

e. Plants are 10 to 12 feet apart; rows are 8 to 10 feet apart

OBJECTIVE 8

Describe factors that affect the ultimate size of fruit and nut trees and berry plants. Describe four factors in the space provided.

NOTE: Objective 9 is evaluated on an assignment sheet in this unit. If you have not completed this component, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

PREPARE A SITE FOR FRUIT AND NUT PRODUCTION

III

OBJECTIVE 1

1.	b	5.	k
2.	j	6.	g
3.	a	7.	d
4.	h	8.	m

OBJECTIVE 2

2, 3, 4, 7, 8, 10

OBJECTIVE 3

1, 2, 4, 6, 8

OBJECTIVE 4

Answers should include one advantage and one disadvantage for each of the following types of orchard soil management programs.

Cultivation –

Advantages:

- Destroys weeds before they bloom.
- Prepares the orchard for irrigation; bare, wet ground retains the most warmth during a frost.

Disadvantages:

- Soil may become compacted more readily than with other management systems; discing wet or very dry soils encourages compaction, which hinders water movement in the soil.
- Cultivated orchards often become more dusty, and dustiness can increase pest problems.
- Cultivation is an expensive system because it requires more orchard care and bigger equipment than other techniques.
- Cultivated orchards are usually several degrees warmer than orchards managed by other methods; this can result in more sunburned fruit. In addition, cultivated orchards stay wet in the winter and spring, which hampers spraying and pruning.

Noncultivation –

Advantages:

- Although initial costs of weed control and equipment may be high, this method becomes cheaper in following years because of only slight weed growth and no discing expense.
- Bare ground stays warmer and can cut down possible frost damage.

Disadvantages:

- This method is suited only to flat or nearly flat ground where water penetrates evenly and there is no runoff.
- Surface sealing may occur after several years, meaning water will not seep evenly into the ground.
- Warmer soil may lead to more sunburned fruit.

Semi-sod culture –

Advantages:

- It is relatively inexpensive and efficient because orchard operations are done only in one direction.
- Sodded middles improve water penetration and, in wet periods, give better footing for equipment.
- Sod remains fairly cool during warm weather and helps control pests such as mites.

Disadvantages:

- Sod does not retain heat so flowers may be endangered by spring frosts.
- This system requires more water (15 to 30 percent) and more nitrogen per acre to satisfy the needs of the trees and sod.

Complete sod culture –

Advantages:

- More suitable for uneven land, such as hillsides where erosion can be a problem.

- Relatively inexpensive and efficient because orchard operations are done only in one direction.
- Sodded middles improve water penetration and, in wet periods, give better footing for equipment.
- Sod remains fairly cool during warm weather and helps control pests such as mites.

Disadvantages:

- Sod does not retain heat so flowers may be endangered by spring frosts.
- This system requires more water (15 to 30 percent) and more nitrogen per acre to satisfy the needs of the trees and sod.

OBJECTIVE 5

1. Disc
2. Tractor
3. Harrow
4. Plow
5. Cultivator
6. Ripper

OBJECTIVE 6

1. b
2. d

OBJECTIVE 7

1. d
2. c
3. a

OBJECTIVE 8

Answers may include any four of the following:

- **Rootstocks** – Some rootstocks may be dwarfing, thus reducing the size of trees.

- **Inherent vigor of variety** – Some varieties are more vigorous than others and will get larger.
- **Soil fertility** – More fertile soil will increase the size of trees and plants.
- **Climate and site** – Length of growing season, sunlight, severity of weather, moisture, will affect size.
- **Pruning** – Pruning can reduce the size of trees, but can also cause greater growth.
- **Amount of fruit set** – The more fruit the tree or plant bears, the less the growth

OBJECTIVE SHEET

PROPAGATE AND PLANT FRUITS AND NUTS

IV

INTRODUCTION

Using seeds to grow fruit and nut crops is usually unsatisfactory, although it may be simple and economical. The seedlings usually differ from their parents in terms of size, shape and fruit quality. However, it is often important to know how to grow fruits and nuts from seed to get understock or rootstock on which to propagate the wood of better varieties. Growers also need to know about planting depths and times to plant crops to give them the best possible chance for success.

UNIT OBJECTIVE

After completing this unit, the student will be able to stratify seeds, know reasons for grafting, describe types of budding and grafting, know how to prepare and store propagation material, and determine planting times and planting depths for various fruit and nut crops. The student will demonstrate these competencies by completing job sheets and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to

1. Match terms associated with propagating and planting fruit and nut crops to their correct definitions.
2. Place in order the steps for stratification of seed.
3. List stratification requirements for various fruit and nut crops.
4. Describe the two types of propagation.
5. Select from a list reasons for grafting.
6. Select from a list requirements needed for a successful graft.
7. Describe budding methods used in fruit and nut production.
8. Distinguish among types of grafts used in fruit and nut production.
9. Choose the correct word or phrase to complete statements about preparing and storing propagation material.
10. Match fruit and nut crops to their correct planting times.

11. Describe how deep to plant various fruit and nut crops.

12. Bud by t-bud method. (Job Sheet 1)

13. Bud by patch method. (Job Sheet 2)

14. Graft by whip and tongue method. (Job Sheet 3)

15. Graft by bark graft method. (Job Sheet 4)

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with propagating and planting fruit and nut crops to their correct definitions.

- Use Information Sheet to discuss terms. When possible, use concrete examples to show students.

Objective 2: Place in order the steps for stratification of seed.

Objective 3: List stratification requirements for various fruit and nut crops.

- Show students examples of various fruit and nut seeds.

- As a class project, try stratifying the various fruit and nut seeds listed in Objective 3. Show students seeds that have been stratified the previous season.

- Have orchard owners discuss how they propagate their plants. Discuss the advantages and disadvantages of "doing it yourself" rather than purchasing nursery stock.

Objective 4: Describe the two types of propagation.

Objective 5: Select from a list reasons for grafting.

Objective 6: Select from a list requirements needed for a successful graft.

- Discuss the advantages and disadvantages of grafting in orchard or field production.
- Give examples of sexual and asexual propagation.
- Discuss the importance of proper grafting; show examples of grafts that did not take.
- Show video *Plant Propagation.*

Objective 7: Describe budding methods used in fruit and nut production.

Objective 8: Distinguish among types of grafts used in fruit and nut production.

- Discuss types of budding and grafting; mention other methods of grafting that may or may not apply to fruit and nut crops.
- Show students examples of trees or vines that have been grafted or budded using the various methods.

Objective 9: Choose the correct word or phrase to complete statements about preparing and storing propagation material.

- Bring in samples of propagation material that has been properly and improperly prepared. Ask students to point out which materials are correctly prepared.
- Take students to an orchard and allow them to select and prepare propagation wood.
- Discuss other places where orchard owners can purchase propagation material. Sometimes local Agricultural Extension offices carry a list of local suppliers.

Objective 10: Match fruit and nut crops to their correct planting times.

Objective 11: Describe how deep to plant various fruit and nut crops.

- Discuss planting times and planting depths using the information sheet.

- Discuss where winter planting may be possible because of climate. Discuss what factors might affect planting times.

- Discuss the importance of proper planting depths.

APPLICATION

Objective 12: Bud by t-bud method.

- Demonstrate how to bud by t-bud method. Have students complete Job Sheet 1.

Objective 13: Bud by patch method.

- Demonstrate how to bud by patch method. Have students complete Job Sheet 2.

Objective 14: Graft by whip and tongue method.

- Demonstrate how to graft by whip and tongue method. Have students complete Job Sheet 3.

Objective 15: Graft by bark graft method.

- Demonstrate how to graft by bark graft method. Have students complete Job Sheet 4.

EVALUATION

Pretest

- Give written test as pretest.

- Determine individual study requirements from pretest results.

- Counsel students individually on pretest results and study requirements.

- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on job sheet activities.

- Complete appropriate section of competency profiles.

- Reteach and reevaluate if necessary.

- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Electronic Media

- *Plant Propagation*, Vol. 1 and 2, 1987. Volume 1 covers propagation by seed, specialized parts, division and micropropagation. Volume 2 covers cuttings, layering, grafting and budding and details rooting hormones and the four main groups of stem cuttings. Order #VT122 (Color, VHS, 40 minutes)

  NOTE: This video is available to Oklahoma teachers on a free-loan basis. Oklahoma teachers may order this video from the Oklahoma Department of Vocational and Technical Education, Resource Center, ATTN: Instructional Media Specialist, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364.

Print Media

- Taylor, Glenn G. "Propagation of Fruit and Nuts by Seed." OSU Extension Fact Sheet No. 6211. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn G. "Collecting and Storing Pecan Propagation Wood." OSU Extension Fact Sheet No. 6217. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn G. "Splice and Tongue Grafting Pecans." OSU Extension Fact Sheet No. 6205. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- Taylor, Glenn G. "Patch Budding Pecans." OSU Extension Fact Sheet No. 6206. Cooperative Extension Service. Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn G. "Propagating Peaches by 'T'-Budding." OSU Extension Fact Sheet No. 6227. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn G. "Four-Flap Grafting of Pecans." OSU Extension Fact Sheet No. 6230. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn G. "Bark Grafting Pecans." OSU Extension Fact Sheet No. 6204. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

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- Taylor, Glenn G. "Propagation of Fruit and Nuts by Seed." OSU Extension Fact Sheet No. 6211. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
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PROPAGATE AND PLANT FRUITS AND NUTS

OBJECTIVE 1

Match terms associated with propagating and planting fruit and nut crops to their correct definitions.

- **bark slipping** — a time when the cambium is actively growing and bark can be pulled back easily

  NOTE: This condition is important when bark grafting.

- **budding** — special type of grafting where a scion is reduced to contain only a single bud
- **budding rubbers** — narrow strips of rubber used to tie grafts and buds in place and prevent drying
- **budstick** — twig used as a source of buds when budding; buds are removed as needed
- **callus** — the mass of cells that develop on plant wounds and help in the healing process
- **cambium** — the soft layer of tissue found between the bark and wood

  NOTE: The cambium, through cell division, is able to produce new bark and wood. This is why it is important that the cambium of the scion be in close contact with the cambium of the stock when grafting.

- **clone** — a cultivar or variety that must be propagated by vegetative methods (such as stem or root cuttings) to retain its distinctive characteristics

  NOTE: All grafted trees of the same variety are also considered clones.

- **dormancy** — rest period required for some seeds to germinate; naturally occurs in late fall and winter
- **girdle** — to cut a section of bark and cambium completely around a stem
- **grafting** — method of attaching two pieces of living plant tissue so that they unite and grow as one plant
- **grafting tape** — non-stick plastic tape used to hold buds and grafts in place and to prevent drying

- **scion** – a shoot containing one or more buds that is attached to the stock or lower portion of the graft

  NOTE: Grafting is done when the buds are dormant.

- **stratification** – the placing of difficult-to-germinate seeds in a layer of sand, sawdust, or peat moss and keeping the mixture cold (but above freezing) for two months or more

- **stock** – the lower portion of the graft; contains the root system

- **propagation** – any method used to increase the number of plants

OBJECTIVE 2

Place in order the steps for stratification of seed.

Some seeds, because of a dormant embryo, must go through a process of "after-ripening" before they can germinate. This after-ripening must be done at the proper temperature and with an ample supply of oxygen and moisture. This is done through stratification.

To stratify seeds:

1. Mix seed with stratification medium (moist sand, sawdust, or peat moss) and place the seed in baskets, crates, jars, or other containers. Make sure seed is packed LOOSELY for good aeration.

   NOTE: If using baskets, line the inside with clean paper to reduce the chances of infection.

2. Place an additional layer (about 1/2 inch thick) of pure peat moss, sand, or sawdust over the stratification mixture.

3. Place paper over the container to help keep the seed moist.

4. Keep stratified seed in a cold room or cellar. Small quantities of the seed can be placed in small jars and kept in a refrigerator.

5. Keep seeds stratified for the recommended period of time – this will vary according to the type of seed and species.

   NOTE: For seeds of some species, fall planting can be used instead of stratification and will save time, labor, and storage space. However, you must make sure the seeds remain moist, are protected from pests, and that the temperature stays low for the necessary amount of time.

OBJECTIVE 3

List stratification requirements for various fruit and nut crops.

- **Pecans** – Do not fall into dormancy, but are commonly stratified or kept in cold storage at high humidity throughout the winter and planted in the spring.
- **Blackberries** – Require stratification at 33 to 35° F before being planted. Average stratification time is three months. September is suggested as the best planting time.
- **Grapes** – Require stratification at 37° F, for 90 to 140 days. Because of the great variation of seedlings, seeds cannot be relied upon to produce a vineyard of the desired variety.
- **Apples** – Seeds are used primarily to produce rootstock. Seed is dormant. Require stratification at 34 to 40° F, for two to two and one-half months.
- **Cherries** – Most seed varieties have a period of dormancy. Stratification requirements vary anywhere from four to 14 weeks at a temperature close to freezing (32° F).
- **Plums** – Require stratification, but time depends on species. The common wild plum of Oklahoma is usually stratified for 60 to 90 days at 34 to 40° F.
- **Peaches** – Stratify for 75 to 100 days at 32 to 45° F. Seeds do well if stratified over the winter and planted in the spring.

OBJECTIVE 4

Describe the two types of propagation.

- **Sexual** – Reproduction involving female (egg) and male (pollen) sex cells producing seed; seeds make new plants.
- **Asexual** – Reproduction using vegetative parts of the original plant such as cuttings from leaves, stems, or roots to make new plants; grafting or budding is used.

OBJECTIVE 5

Select from a list reasons for grafting.

Although some plants can be propagated by cuttings, some of the major tree fruits, such as apples, pears, peaches, cherries, most plums, and pecans, are difficult to grow this way. These fruits and nuts, therefore, are propagated by growing seedlings or rootstock cuttings, and grafting or budding the desired cultivar on them.

- Some plants do not produce seeds.

- Plants produced from seeds do not produce plants with the same qualities as the parent plant.
- Grafts are made to allow for better pollination.

  NOTE: The varieties planted may not pollinate properly so other varieties may be grafted onto some of these trees.
- Grafts are made to create dwarf trees.
- Grafting can help strengthen a tree's framework or help repair injured or diseased parts.
- Grafting can improve hardiness or growth habits, such as disease and pest resistance, by taking advantage of the benefits of certain stocks.
- Grafting can be used to change the cultivars of established plants.

OBJECTIVE 6 **Select from a list requirements needed for a successful graft.**

- The stock and scion must be compatible so that the two will grow as one.

  EXAMPLE: Apple on peach is NOT compatible.
- The cambium of the stock and scion must be tightly joined.

  NOTE: This can be done by nailing, wrapping, wedging, etc.
- Grafting must be done when the stock and scion are in the right stage of growth or dormancy.

  NOTE: Scion buds should be dormant and stock can be dormant or growing, depending on the method of grafting.
- Grafted area must be properly protected or covered.
- Grafts must be tended properly for some time after the grafting is done.

OBJECTIVE 7 **Describe budding methods used in fruit and nut production.**

Trees must be actively growing at the time of budding. Budding methods include:

- **patch bud** – transfer of bud and bark only, no wood included; one of the easiest methods

- **chip bud** – must include the wood behind the bud; difficult to fit size of bud to stock

- **t-bud** – may or may not include wood behind the bud

  NOTE: If wood is removed, special care must be taken to ensure that the vascular system to the bud remains intact and extends slightly out the back of the bud.

OBJECTIVE 8 **Distinguish among types of grafts used in fruit and nut production.**

NOTE: Pecan growers do more grafting than other fruit and nut growers.

- **whip and tongue** – used for hardwood cuttings, roots, and rootstock scion grafts; fairly simple method; usually done in the dormant season

  EXAMPLES: Grape, pecan

- **bark** – scion is inserted under the bark; extremely easy method; must be done when bark is slipping on the stock; scion must be dormant

  NOTE: The bark is slipping when the cambium is actively growing and can be pulled back easily.

- **four-flap** – four vertical cuts on the stock; used any time the plant is actively growing or slipping and scion is dormant; very easy method

OBJECTIVE 9 **Choose the correct word or phrase to complete statements about preparing and storing propagation material.**

NOTE: These steps apply to pecan propagation wood, but also hold true for other propagation materials.

WARNING: Many fruit varieties are patented and may not be legally propagated without a license.

- Collect material in the late winter – February or early March – while tree is still dormant.

- Collect healthy one-year-old (current season) wood. This age is best for bark grafting, splice and tongue grafting, and patch budding.

- Wood that is 3/8 to 3/4 inch diameter is best for patch budding; scions that are 1/4 to 1/2 inch in diameter are preferred for grafting.

- Label all wood as it is cut from the parent tree.

- Wrap moist burlap sacks around the wood to prevent it from drying out.

- Remove the terminal end (the end with the growth tip), making square cuts.

  NOTE: The best scions are usually those cut from the center or bottom two-thirds of each shoot.

- Cut the wood into 6, 12, or 18-inch lengths, and bundle them according to size. Each 6-inch length will make a scion.

- Bundle the wood using twine to tie both ends. This will keep the sticks from moving and knocking off the buds.

- Label the wood using a waterproof material. This can be done by making a slash on the lower end of the wood and writing the variety name in pencil.

- Pack the wood in a moist material such as sphagnum moss, sawdust, or wood shavings, then place in containers such as crates, boxes, or airtight polyethylene bags.

- Store the wood where the temperature is 30° to 35° F. Refrigerate, do not freeze, the wood.

OBJECTIVE 10 **Match fruit and nut crops to their correct planting times.**

Planting times vary with the area or region. In northern areas of the United States, trees are planted in early spring because fall frost could injure or even kill young plants.

In areas where winters are milder, trees may be planted in the fall or winter. Tests have shown trees planted at this time have more growth during the first season.

Remember, planting time may also depend on the variety of the fruit or nut. Some cultivars can endure colder temperatures than others.

Here are the suggested planting times for fruit and nut crops in Oklahoma:

Pecans – Spring

Apples – Fall or spring

Peaches and nectarines – Fall or spring

Plums – Fall or spring

Cherries – Fall or spring

Pears – Fall or spring

Strawberries – Spring

Blackberries – Spring

NOTE: Strawberries and blackberries are usually planted this time of year because plants are more readily available

Blueberries – Early spring

Grapes – Spring

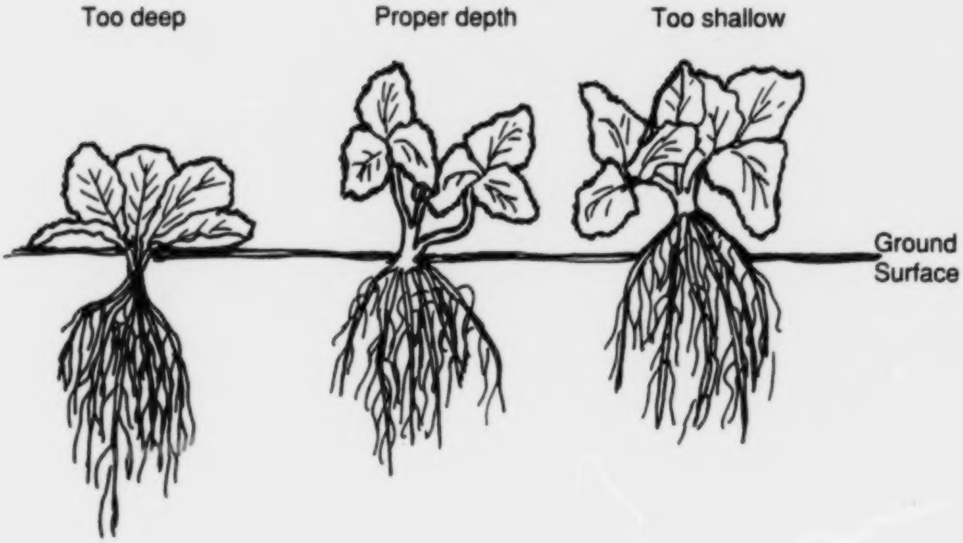
OBJECTIVE 11

Describe how deep to plant various fruit and nut crops.

- **Fruit and nut trees** – Plant at the same depth as it grew in the nursery.
- **Blackberries** – Plant slightly deeper than the depth it grew in the nursery.
- **Blueberries** – Plant at the same depth as it grew in the nursery.
- **Grapes** – Plant at the same depth as it grew in the nursery.
- **Strawberries** – Plants should be set so that the crown is half-way emerged from the ground, but no roots are showing.

  NOTE: If planted too deep, soil will cover the crown and kill the strawberry plant; if planted too shallow, the roots will become exposed and the plant will die.

CORRECT PLANTING DEPTH FOR STRAWBERRIES


Too deep
Proper depth
Too shallow
Ground Surface

Plant a fruit or nut tree using a planting board.

The use of a planting board is an old but reliable method of ensuring that orchard trees are planted at the correct depth and are spaced correctly.

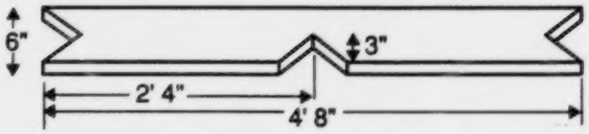
Before planting, be sure to check your nursery stock. Ideally, the fruit and nut trees you buy should not be older than two years. You also need to check the number and variety of stock, signs of disease, pests, and weakness, such as brittle wood.

The materials and tools you will use are:

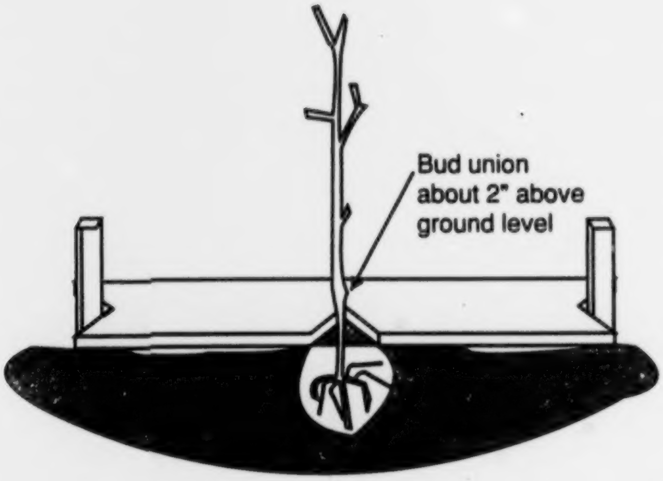
- Planting board and stakes
- Shovel or mechanical digger
- Water
- Pruners
- Bare-root trees

1. Keep soil around tree roots moist. Bare-root trees, especially, dry out quickly when left out in the sun or dry air.
2. Use a planting board to make sure trees are spaced correctly and at the proper depth. Place the "V" of the board at the stake where the tree is to be planted. Drive a stake at either end of the board, then remove the board.

PLANTING BOARD



USING A PLANTING BOARD



3. Dig a hole at the center of the stakes. The hole should be slightly larger than the root system of the tree.

   NOTE: Holes can be dug with a shovel, mechanical post hole digger, or a backhoe.

4. Prune off any damaged roots.

5. Settle or firm the soil in the hole with water.

6. Place the tree in the hole, making sure roots are not matted. Put the planting board back in place, using it to make sure the graft union of the tree is about 2 inches above ground level. The side of the tree with the most branches should be placed in a northerly direction.

7. Place soil around the roots and pack gently to get rid of air pockets. Continue filling the hole.

8. Water tree, and remove planting board.

9. Have instructor check your work.

10. Put away tools and clean up work area.

JOB SHEETS 1-4

Development of:
READING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading and employability skills are important.

- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  EMPLOYABILITY

  - Mastering a specific job task/procedure

  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:

  - Discuss the possible consequences of not following instructions precisely.

  - Have them read the instructions several times, noting the key words and ideas.

  - Explain to students that illustrations are also part of the instructions. Encourage them to compare their work to that shown in photographs and drawings.

  - Have students put the instructions in their own words.

- If students have difficulty mastering a specific job task/procedure:

  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.

  - Suggest they study each component of the procedure to determine which area is causing difficulty.

  - Review the entire procedure.

  - Team them with proficient students or professionals to practice the procedure.

- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.
  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment and in the success or failure of self-employment.
  - Discuss what behaviors and attitudes constitute good work habits.
  - Make sure students know what is expected of them.

OBJECTIVE 12

Bud by t-bud method.

NOTE: This is a common procedure for most trees, but is not often used on pecans.

TOOLS AND MATERIALS

- Budstick 1/4" to 1" in diameter
- Rootstock 1/4" to 1" in diameter

NOTE: Rootstock and bud wood must be compatible.

- Sharp knife
- Plastic grafting tape or budding rubbers
- Tag

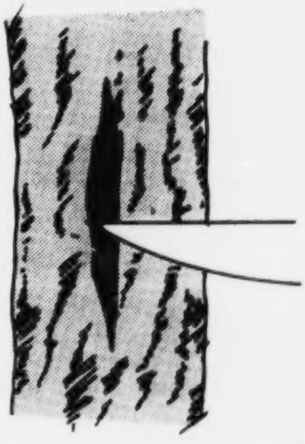
PROCEDURE

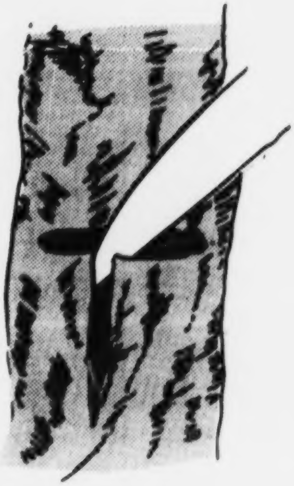
Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
1. Select bud wood with bark slipping and of proper size.	____	____
2. Select rootstock with bark slipping and of proper size.	____	____
3. Make the "T" incision on the rootstock, through the bark.		
a. Make vertical cut 1" long.	____	____
b. Make horizontal cut 1/3 distance around stock.	____	____

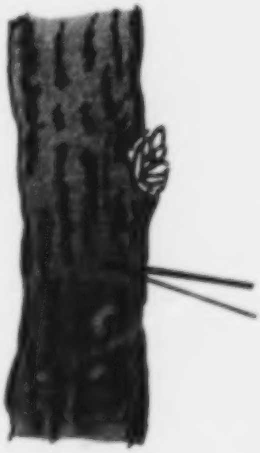
NOTE: Twist knife slightly to open the flaps.

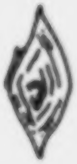




Yes No

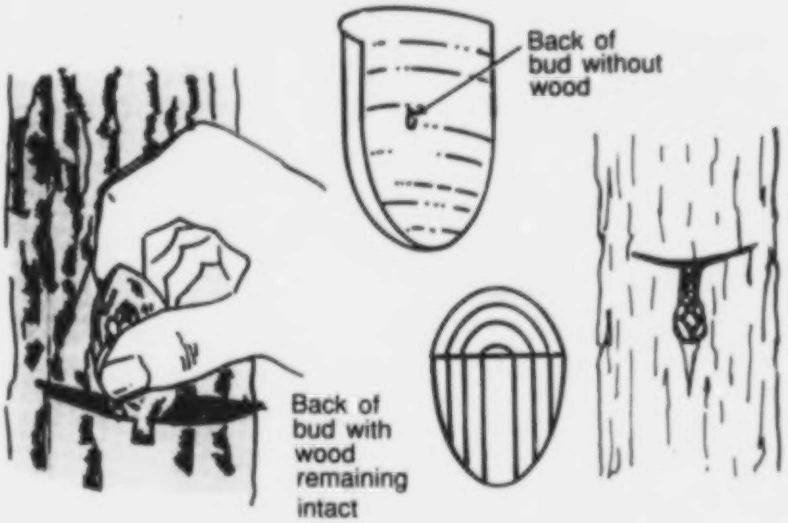
4. Prepare bud – Make incision beginning 1/2" below selected bud and ending 1" above bud. ____ ____





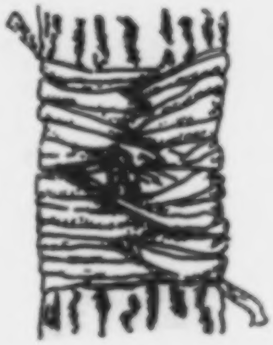
5. Place bud in the "T" incision by pushing bud downward under the two flaps of bark until bud is completely inserted. ____ ____

NOTE: The wood may or may not be removed from inside the bud. If the wood is removed, the center of the bud containing the vascular system **must** be intact or bud will not grow. Remove wood **very** carefully.


Back of bud without wood
Back of bud with wood remaining intact

	Yes	No
6. Tie bud in place with either grafting tape or budding rubbers.	____	____

⚠ **CAUTION:** Do not cover the bud when tying into place or growth will not take place.



7. Label bud location.	____	____
8. Have your instructor check your work.	____	____
9. Put away tools and materials and clean the work area.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Made "T" incision	4	3	2	1
Prepared bud	4	3	2	1
Placed bud into incision	4	3	2	1
Tied bud in place	4	3	2	1

EVALUATOR'S COMMENTS

____

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____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** — Can perform job with no additional training
3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
1 **Unskilled** — Is familiar with process, but is unable to perform job

OBJECTIVE 13

Bud by patch method.

NOTE: This method is most common on pecans, but is also used on apple and pear stock. It is less commonly used on peaches.

TOOLS AND MATERIALS

- Budstick 1/4" to 1" in diameter
- Rootstock 1/4" to 1" in diameter
- Cutting tool such as double blade knife, single blade knife, adjustable razors, or patcher tool
- Plastic grafting tape or budding rubbers
- Label or tag

PROCEDURE

Functional Reading Skills

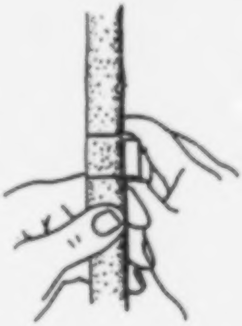
- Follow written instructions

Job Acquisition/ Development Skills

- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

1. Select proper rootstock. ____ ____
2. Select proper budstick. ____ ____
3. Make incisions on rootstock using single or double blade knife. ____ ____



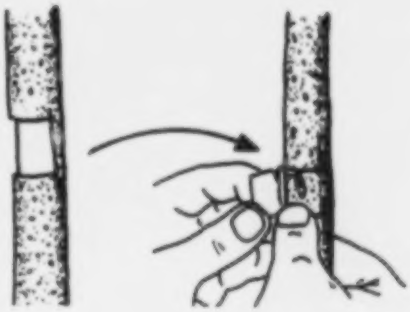
Courtesy of Oklahoma State University Agricultural Extension Service.

4. Make identical cuts on budstick. ____ ____

Yes No

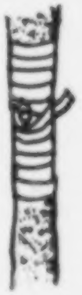
5. Transfer the bud into the stock. ____ ____

NOTE: Do not remove bark patch from stock until ready to insert bud or bud may dry out.



Courtesy of Oklahoma State University Agricultural Extension Service.

6. Tie bud in place, being careful not to cover the bud. ____ ____



Courtesy of Oklahoma State University Agricultural Extension Service.

7. Label the bud location. ____ ____

8. Have your instructor check your work. ____ ____

9. Put away tools and materials and clean the work area. ____ ____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Cut rootstock	4	3	2	1
Cut budstick	4	3	2	1
Transferred bud into stock	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** — Can perform job with no additional training
3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
1 **Unskilled** — Is familiar with process, but is unable to perform job

JOB SHEET 3

PROPAGATE AND PLANT FRUITS AND NUTS

IV

OBJECTIVE 14

Graft by whip and tongue method.

NOTE: This method is used on pecans, apples, pears, and other tree fruits, but is not common on peaches.

TOOLS AND MATERIALS

- Scion 1/4" to 1/2" in diameter
- Stock 1/4" to 1/2" in diameter
- Very sharp knife
- Grafting tape or masking tape
- Label or tag

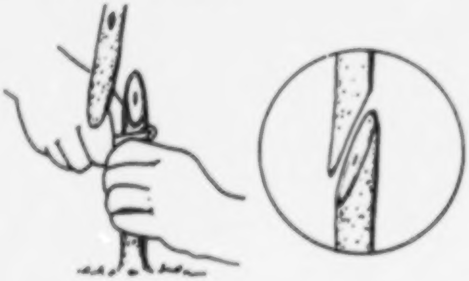
PROCEDURE

Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

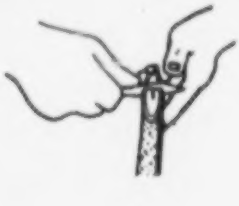
Yes No

1. Make smooth sloping cut on top end of stock. The face of the cut should be 2" to 3" long. ____ ____



Courtesy of Oklahoma State University Agricultural Extension Service.

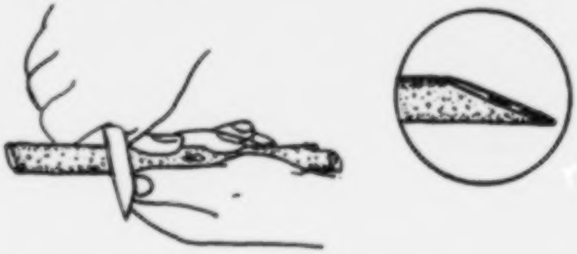
2. Make smooth sloping cut on basal end of scion to match cut on stock. ____ ____



Courtesy of Oklahoma State University Agricultural Extension Service.

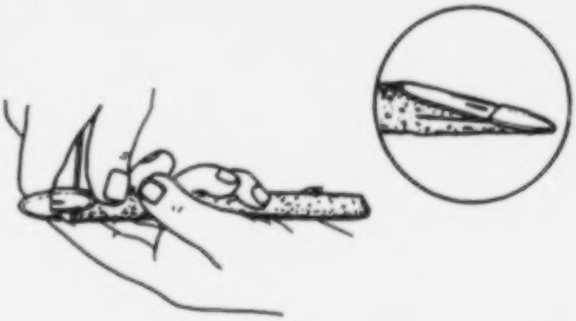
Yes No

3. For the tongue, make a cut on the stock 1/3 of the distance from tip to base of first cut, pressing the knife downward into the trunk. ____ ____



Courtesy of Oklahoma State University Agricultural Extension Service.

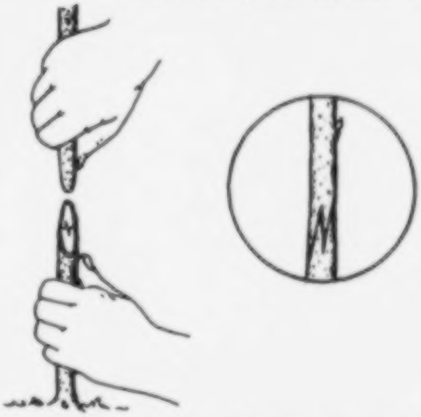
4. Make a similar cut on the scion. ____ ____



Courtesy of Oklahoma State University Agricultural Extension Service.

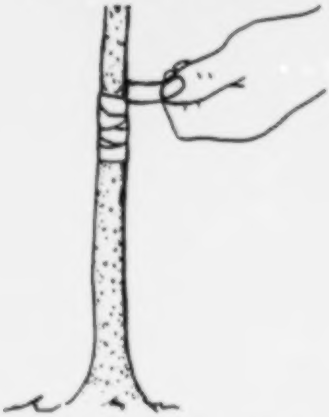
5. Slip the two cut surfaces together and interlock. ____ ____

NOTE: The cambium of the two pieces **must** be in complete contact for growth to occur.



Courtesy of Oklahoma State University Agricultural Extension Service.

	Yes	No
6. Wrap the grafted area tightly with masking tape or grafting tape to keep it airtight and hold it firmly.	____	____



Courtesy of Oklahoma State University Agricultural Extension Service.

	Yes	No
7. Label graft.	____	____
8. Have your instructor check your work.	____	____
9. Put away tools and materials and clean the work area.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

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____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Cut on top end of stock	4	3	2	1
Cut on basal end of stock	4	3	2	1
Interlocked surfaces	4	3	2	1
Tied graft	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

OBJECTIVE 15 **Graft by bark graft method.**

NOTE: This is the most common method of grafting used by pecan growers in Oklahoma. It is also used on apples and pears, but not on peaches.

TOOLS AND MATERIALS

- Stock 1" to 2"
- 1 scion 2 1/2" in width with 2 or 3 buds, 6" long

NOTE: Scions should be dormant; store in cooler in moist peat until needed.

- Sharp knife
- Saw
- Aluminum foil
- Nails, 5/8" to 3/4" long, #18 gauge wire
- Small hammer
- Rubber band
- Polyethylene bag

PROCEDURE

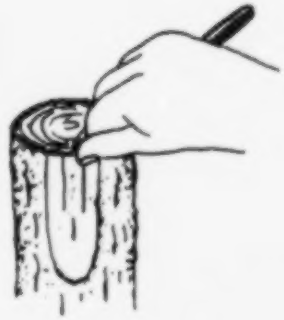
	Yes	No
1. Saw off stock to desired graft location.	____	____
2. Make two parallel, vertical cuts 1" to 2" long through bark.	____	____

NOTE: Width of cuts should match the width of the scion.

	Yes	No
3. Loosen the flap at the top with the tip of the knife blade.	____	____

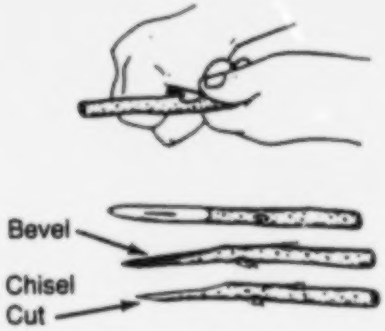
Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes



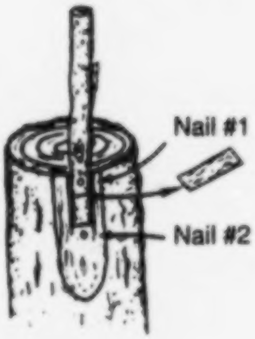
Courtesy of Oklahoma State University Agricultural Extension Service.

	Yes	No
4. Prepare scion.		
a. Make a long, sloping cut on basal end of scion, 2" to 3 1/2" long.	____	____
b. Make shorter cut on opposite side, 1/2" long.	____	____



Courtesy of Oklahoma State University Agricultural Extension Service.

	Yes	No
5. Insert scion into stock.	____	____
a. Slide end of scion under flap portion of stock.	____	____
b. Leave about 1/8" of sloping cut above the top of stock to allow callus to form.	____	____
c. Remove about half of the bark flap.	____	____
d. Nail scion into place with flathead nails or brads.	____	____



Courtesy of Oklahoma State University Agricultural Extension Service.

	Yes	No
6. Cover stub with aluminum foil, leaving top of scion exposed.	____	____
7. Cut corner of polyethylene bag and slip it over stock so that scion is sticking out of the hole in bag. Use rubber band to tie bag around scion. Secure bag to stock with string.	____	____
8. Have your instructor check your work.	____	____
9. Put away tools and materials and clean the work area.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Made cuts	4	3	2	1
Prepared scion	4	3	2	1
Inserted scion into stock and nailed it	4	3	2	1
Covered stub with foil	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

WRITTEN TEST

PROPAGATE AND PLANT FRUIT AND NUT CROPS

IV

Name ______________________________ Score __________

OBJECTIVE 1

Match terms associated with propagating and planting fruit and nut crops to their correct definitions. Write the letter of the correct answer in the blank.

Part I

___ 1. Non-stick plastic tape used to hold buds and grafts in place, and to prevent drying

___ 2. Rest period required for some seeds to germinate; naturally occurs in late fall and winter

___ 3. To cut a section of bark and cambium completely around a stem

___ 4. A time when the cambium is actively growing and bark can be pulled back easily

___ 5. A shoot containing one or more buds that is attached to the stock or lower portion of the graft

___ 6. The placing of difficult-to-germinate seeds in a layer of sand, sawdust, or peat moss and keeping the mixture cold (but above freezing), for two months or more

___ 7. Special type of grafting where a single bud is used as a scion

___ 8. Method of attaching two pieces of living plant tissue so that they unite and grow as one plant.

a. dormancy

b. budding

c. bark slipping

d. pruning

e. grafting

f. splicing

g. grafting tape

h. girdle

i. stratification

j. scion

k. engraving

l. cultivar

May be photocopied for student use.

Part II

____ 1. Narrow strips of rubber used to tie grafts and buds in place and prevent drying

____ 2. Twig used as a source of buds when budding; buds are removed as needed

____ 3. The soft layer of tissue found between the bark and wood

____ 4. Any method used to increase the number of plants

____ 5. A cultivar or variety that must be propagated by vegetative methods (such as stem or root cuttings) to retain its distinctive characteristics

____ 6. The lower portion of the graft; contains the root system

____ 7. The mass of cells that develop on plant wounds and help in the healing process

a. cork
b. budding rubbers
c. bud bank
d. budstick
e. mutant
f. clone
g. callus
h. cambium
i. propagation
j. stock
k. taproot

OBJECTIVE 2

Place in order the steps for stratification of seed. Number the steps from "1" to "5," writing the correct number in the blank before each step.

____ Place paper over the container to help keep the seed moist.

____ Keep stratified seed in a cold room or cellar. Small quantities of the seed can be placed in small jars and kept in a refrigerator.

____ Mix seed with stratification medium (moist sand, sawdust, or peat moss) and place the seed in baskets, crates, jars, or other containers. Make sure seed is packed LOOSELY for good aeration.

____ Keep seeds stratified for the recommended period of time – this will vary according to the type of seed and species.

____ Place an additional layer (about 1/2 inch thick) of pure peat miss, sand, or sawdust over the stratification mixture.

May be photocopied for student use.

OBJECTIVE 3 **List stratification requirements for various fruit and nut crops.** Write the requirements in the space provided.

Pecans – ______________________________

____

____

Blackberries – ______________________________

____

____

Grapes – ______________________________

____

____

Apples – ______________________________

____

____

Cherries – ______________________________

____

____

Plums – ______________________________

____

____

Peaches – ______________________________

____

____

May be photocopied for student use.

OBJECTIVE 4

Describe the two types of propagation. Write your answers in the space provided.

1. Sexual – ______________________________

____

____

2. Asexual – ______________________________

____

____

OBJECTIVE 5

Select from a list reasons for grafting. Place an "X" in front of the correct answers.

___ 1. Some plants do not produce seeds.

___ 2. Grafting will double the lifespan of a tree.

___ 3. Grafts will produce only trees of the same sex.

___ 4. Grafting can improve hardiness or growth habits such as disease and pest resistance by taking advantage of the benefits of certain stocks.

___ 5. Grafts are made to create dwarf trees.

___ 6. Grafting will weaken a tree, but make it produce more fruit.

___ 7. Grafting creates wounds that allow more nourishment for the tree or vine.

___ 8. Plants produced from seeds do not produce plants with the same qualities as the parent plant.

OBJECTIVE 6

Select from a list the requirements needed for a successful graft. Place an "X" in front of the correct answers.

___ 1. Both stock and scion must be actively growing.

___ 2. The stock and scion must be compatible.

___ 3. Grafts must be tended properly for some time after grafting is done.

May be photocopied for student use.

____4. Graft must be loosely wrapped to allow air circulation.

____5. Grafted area must be properly protected or covered.

____6. Grafts must be made on plants 5 years or older.

OBJECTIVE 7

Describe budding methods used in fruit and nut production. Write you answer in the space provided.

patch bud – ____

____

____

chip bud – ____

____

____

t-bud – ____

____

____

OBJECTIVE 8

Distinguish among types of grafts used in fruit and nut production. Write "WT" in the blank before statements describing whip and tongue grafts. Write "B" in the blanks before statements describing bark grafts. Write "FF" in the blanks before statements describing four flap grafts.

___ 1. Scion is inserted under the bark; extremely easy method

___ 2. Four vertical cuts on the stock

___ 3. Used for hardwood cuttings, roots, and rootstock scion grafts; fairly simple method; usually done in the dormant season

___ 4. Used any time the plant is actively growing or slipping; very easy method

___ 5. Must be done when bark is slipping on the stock; scion must be dormant

OBJECTIVE 4

Choose the correct word or phrase to complete statements about preparing and storing propagation material. Write the correct letters in the blanks.

___ 1. Material for propagation should be collected in

a. late winter
b. early summer
c. mid fall
d. late spring

___ 2. Wood for propagation should be healthy and

a. two-years-old
b. three-years-old
c. one-year-old
d. four-years-old

___ 3. Wood for patch budding should be

a. 1 to 1 1/2 inch diameter
b. 3/8 to 3/4 inch diameter
c. 1/4 to 1/2 inch diameter
d. 1 1/2 to 2 inch diameter

___ 4. Wood which is cut from the parent tree should be

a. close to the ground
b. stripped of all bark
c. easily broken
d. labeled

___ 5. Wrap moist burlap sacks around the wood to prevent it from

a. growing
b. being in sunlight
c. drying out
d. loosing its bark

___ 6. The "terminal end" means the same thing as the end with the

a. growth tip
b. root system
c. leaves
d. branches

May be photocopied for student use.

___ 7. Wood should be cut into

a. 5, 10, 15 inch lengths
b. 3, 9, 13 inch lengths
c. 1, 2, 3 inch lengths
d. 6, 12 or 18 inch lengths

___ 8. Bundling the wood securely keeps it from moving and

a. rubbing off bark
b. knocking off leaves
c. knocking off buds
d. ruining the root system

___ 9. Wood should be labeled with

a. a waterproof material
b. a crayon
c. water soluble ink
d. any felt tip marker

___ 10. Wood should be packed in sphagnum moss, sawdust, or other

a. non-biodegradable material
b. moist material
c. synthetic material
d. cheap material

___ 11. Wood should be

a. refrigerated
b. frozen
c. left in sunlight
d. heated

May be photocopied for student use.

OBJECTIVE 10 **Match fruit and nut crops to their correct planting times.** Write the letter of the correct answer in the blank.

___ 1. Pecans

___ 2. Apples

___ 3. Peaches and nectarines

___ 4. Plums

___ 5. Cherries

___ 6. Pears

___ 7. Strawberries

___ 8. Blackberries

___ 9. Blueberries

___ 10. Grapes

a. spring

b. early spring

c. fall

d. fall or spring

OBJECTIVE 11 **Describe how deep to plant nursery various fruit and nut crops.** Write the correct answers in the space provided.

Fruit and nut trees – ______________________________

____

____

Blackberries – ______________________________

____

____

Blueberries – ______________________________

____

____

May be photocopied for student use.

Grapes – ____

____

____

Strawberries – ____

____

____

NOTE: Objectives 12-15 are evaluated on a job sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use.

OBJECTIVE 1

Part I	Part II
1. g	1. b
2. a	2. d
3. h	3. h
4. c	4. i
5. j	5. f
6. i	6. j
7. b	7. g
8. e	

OBJECTIVE 2

3, 4, 1, 5, 2

OBJECTIVE 3

Answers should include the following requirements:

Pecans – Do not fall into dormancy, but are commonly stratified or kept in cold storage at high humidity throughout the winter and planted in the spring.

Blackberries – Require stratification at 33° to 35° F before being planted. Average stratification time is 3 months. September is suggested as the best planting time.

Grapes – Require stratification at 37° F, and for 90 to 140 days. Because of the great variation of seedlings, seeds cannot be relied upon to produce a vineyard of the desired variety.

Apples – Seeds are used primarily to produce rootstocks. Seed is dormant. Require stratification at 34° to 40° F, for 2 to 2 1/2 months.

Cherries – Most seed varieties have a period of dormancy. Stratification requirements vary anywhere from four to 14 weeks at a temperature close to freezing (32° F).

Plums – Require stratification, but time depends on species. The common wild plum of Oklahoma is usually stratified for 60 to 90 days at 34° to 40° F.

Peaches – Stratify for 75 to 100 days at 32° to 45° F. Seeds do well if stratified over the winter and planted in the spring.

OBJECTIVE 4

1. Sexual – Reproduction involving female (egg) and male (pollen) sex cells producing seed; seeds make new plants.
2. Asexual – Reproduction using vegetative parts of the original plant such as cuttings from leaves, stems, or roots to make new plants; grafting or budding is used.

OBJECTIVE 5

1, 4, 5, 8

OBJECTIVE 6

2, 3, 5

OBJECTIVE 7

Answer should include the following:

- **patch bud** – transfer of bud and bark only, no wood included; one of the easiest methods
- **chip bud** – must include the wood behind the bud; difficult to fit size of bud to stock
- **t-bud** – may or may not include wood behind the bud

OBJECTIVE 8

1. B
2. FF
3. WT
4. FF
5. B or FF

OBJECTIVE 9

1. a
2. c
3. b
4. d
5. c
6. a
7. d
8. c
9. a
10. b
11. b

OBJECTIVE 10

1. a
2. d
3. d
4. d
5. d
6. d
7. a
8. a
9. b
10. a

OBJECTIVE 11

Answers should include the following descriptions:

Fruit and nut trees – Plant at the same depth as it grew in the nursery.

Blackberries – Plant slightly deeper than the depth it grew in the nursery.

Blueberries – Plant at the same depth as it grew in the nursery.

Grapes – Plant at the same depth as it grew in the nursery.

Strawberries – Plants should be set so that the crown is half-way emerged from the ground but no roots are showing.

OBJECTIVE SHEET

MAINTAIN FRUIT AND NUT CROPS

V

INTRODUCTION

After planting fruit and nut crops, maintaining orchards, vineyards or fields becomes an important job. It may, however, be important to consider pollination requirements for some crops before planting. Pruning, training, and fruit thinning are essential in keeping trees, vines, and berry plants healthy and productive. Later units will explore other needs such as fertilization, pest control, and weed control.

UNIT OBJECTIVE

After completing this unit, the student will know reasons for pruning, methods of pruning, pollination requirements, and thinning methods; and will be able to prune various ages of trees. The student will demonstrate these competencies by completing assignment sheets, job sheets, and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with maintaining fruit and nut crops to their correct definitions.
2. Match tools for pruning to their correct uses.
3. Select from a list reasons for pruning fruit trees, nut trees, berry vines, and bushes.
4. Describe the three methods of pruning fruit and nut trees.
5. Complete sentences describing pruning needs for various fruit and nut crops.
6. Describe the types of pollination requirements.
7. Match various fruit trees, nut trees, and berries to their correct pollination methods.
8. List possible solutions to pollination problems.
9. Select from a list reasons for fruit thinning.
10. Describe the three methods of thinning.
11. Match various types of fruits to their thinning requirements.

12. Match various procedures for pecan producers with the correct month of the year. (Assignment Sheet 1)

13. Prune a one-year peach tree. (Job Sheet 1)

14. Prune a two-year apple tree. (Job Sheet 2)

15. Spread branches on a fruit tree. (Job Sheet 3)

16. Construct trellis and prune grape vine using the 4-cane kniffin system. (Job Sheet 4)

SUGGESTED ACTIVITIES

MAINTAIN FRUIT AND NUT CROPS

V

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.

- Study the specific objectives to determine those you will cover in your presentation. Decide which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

- Gather pruning tools to show class.

- Locate trees, vines or berry bushes that need pruning and can be used for class presentation.

- Locate trees that need fruit thinning.

DELIVERY

Objective 1: Match terms associated with maintaining fruit and nut crops to their correct definitions.

- Use the Information Sheet to discuss terms. When possible, show students examples of items discussed.

Objective 2: Match tools for pruning to their correct uses.

- Show students examples of various pruning tools, if available.

- Discuss safety and care of pruning tools. Refer to the "Hand and Power Tools" unit of CIMC's *Introduction to Horticulture*.

- Show proper use of pruning tools.

Objective 3: Select from a list reasons for pruning fruit trees, nut trees, berry vines, and bushes.

Objective 4: Describe the three methods of pruning fruit and nut trees.

Objective 5: Complete sentences describing pruning needs for various fruit and nut crops.

- Refer to the "Introduction to Pruning" unit in CIMC's *Introduction to Horticulture* book. Discuss how to make a proper pruning cut.
- Show students examples of the three types of tree pruning. Discuss the pros and cons of each method.
- Show before and after pictures of trees and vines that have been pruned.
- Invite a pruning specialist to talk to the class.

Objective 6: Describe the types of pollination requirements.

Objective 7: Match various fruit trees, nut trees, and berries to their correct pollination methods.

Objective 8: List possible solutions to pollination problems.

- Have an orchardist or extension agent talk about pollination requirements for various fruits and nuts. Discuss pollination problems that might be of particular concern in your area.
- Show examples of what can happen with poor pollination.
- Invite a beekeeper to class to discuss how bees and insects can improve pollination in a field or orchard.

Objective 9: Select from a list reasons for fruit thinning.

Objective 10: Describe the three methods of thinning.

Objective 11: Match various types of fruits to their thinning requirements.

- Show examples of chemicals used for thinning. Describe the dangers or problems involved with using chemicals; EMPHASIZE SAFETY!
- Describe which thinning methods work best for various crops. Note that some growers may use a combination of thinning methods, i.e. chemical thinning followed by manual thinning.

- Show examples of what can happen when thinning is done improperly or not at all.

  Examples: broken limbs, small fruit.

  NOTE: Trees that produce an abundance of small fruit are not necessarily cost effective because more labor is required to pick the fruit, and the fruit is not as desirable.

APPLICATION

Objective 12: Match various procedures for pecan producers with the correct month of the year. (Assignment Sheet 1)

- Emphasize the importance of planning and keeping records when farming.
- Have students complete Assignment Sheet 1.

Objective 13: Prune a one-year peach tree. (Job Sheet 1)

Objective 14: Prune a two-year apple tree. (Job Sheet 2)

- Discuss the importance of proper pruning in the tree or plant's early years to make pruning easier as the trees continue to grow. Discuss annual pruning of fruit and nut trees and vines.
- Allow students to practice job sheet skills before testing.
- Have students complete Job Sheets 1 and 2.

Objective 15: Spread branches on a fruit tree. (Job Sheet 3)

- Describe methods of spreading; show examples of spreaders. If materials are available, allow students to make their own spreaders with wood and nails, etc.
- Have students complete Job Sheet 3.

Objective 16: Construct trellis and prune grape vine using the 4-cane kniffin system. (Job Sheet 4)

- Discuss the various types of trellises used for grape vines (and berry vines).
- Discuss various pruning methods for grapes. Methods may vary according to the type of grape.
- Have students complete Job Sheet 4.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print media

- Gallott, Jim. "Annual Pruning of Fruit Trees." OSU Fact Sheet No. 6228. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn. "Pollination Requirements for Fruits and Nuts." OSU Fact Sheet No. 6229. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- Taylor, Glenn. "A Calendar for Pecan Growers." OSU Fact Sheet No. 6200. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

UNIT REFERENCES

- Baudendistel, Robert F. *Horticulture: A Basic Awareness.* Reston Publishing Company, A Prentice-Hall Company: Reston, VA, 1979.
- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications: Gainesville, FL, 1983.
- *Fruits and Berries.* The American Horticultural Society: Mount Vernon, VA, 1982.
- Gallott, Jim. "Annual Pruning of Fruit Trees," OSU Fact Sheet No. 6228. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Company: Houston, TX, 1978.
- Mullinix, Mark K., and Bob R. Stewart. *Fruit and Vegetable Production Unit for Plant Science Core Curriculum.* Instructional Materials Laboratory, University of MO-Columbia: Columbia, MO, June 1984.
- *Pecan Production in the Southeast, A Guide for Growers.* (Circular ANR-459). Alabama Cooperative Extension Service: Auburn University, 1989.
- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction, 1982.
- Reiley, Edward H. and Carroll L. Shry Jr. *Introductory Horticulture.* 3rd ed. Delmar Publishers Inc., Albany, NY, 1988.
- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.
- Taylor, Glenn. "Pollination Requirements for Fruits and Nuts," OSU Fact Sheet No. 6229. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Taylor, Glenn. "A Calendar for Pecan Growers," OSU Fact Sheet No. 6200. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Whitworth, Julia. "Commercial Blackberry Production," OSU Fact Sheet 6239. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

INFORMATION SHEET	MAINTAIN FRUIT AND NUT CROPS	V

OBJECTIVE 1

Match terms associated with maintaining fruit and nut crops to their correct definitions.

- **alternate bearing** – producing a heavy crop one year, and little or no fruit the next year
- **biennial** – plant that takes two seasons to complete its life cycle, the first season for vegetative growth and the second for flowering and fruiting

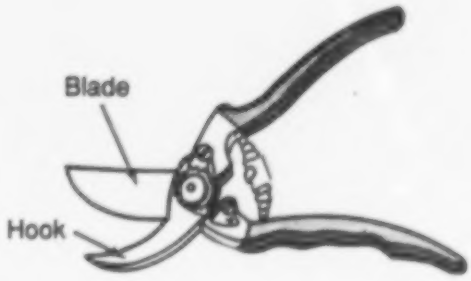
  EXAMPLE: Blackberry (canes only – crown and roots are perennial)
- **floricanes** – second season canes on a blackberry plant, which die after fruiting (Formerly prima canes)
- **monoecious** – tree with both male and female flowers
- **pollination** – transfer of pollen grains from a male flower to the stigma of the female flower or pistil to set a crop of fruit
- **primocanes** – new canes on a blackberry plant that are formed each season and produce flowers and fruit the following season
- **prune** – to cut dead or living parts from a plant in order to increase fruit or flower production; to improve the form or to remove dead or diseased parts

  NOTE: The four "D's" of pruning are to remove dead, diseased, deranged, and drying parts.
- **spreading** – process by which upright-growing branches are bent to a near horizontal position and held there
- **thinning** – removing young fruit from a tree or vine to produce a healthier crop and plant

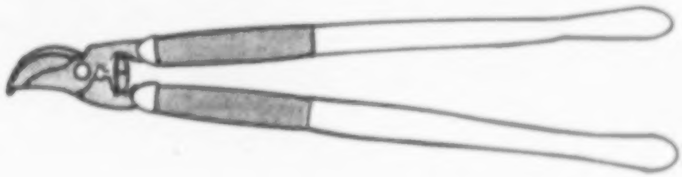
  NOTE: Lack of thinning can lead to alternate bearing and poor fruit or nut quality

OBJECTIVE 2 **Match tools for pruning to their correct uses.**

- **hand pruner** – used to prune small branches no larger than a pencil

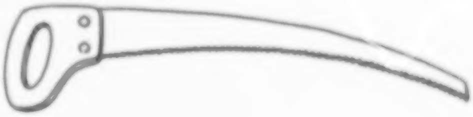


- **lopping shears (loppers)** – used for pruning branches from pencil-size to 1¼ inch in diameter



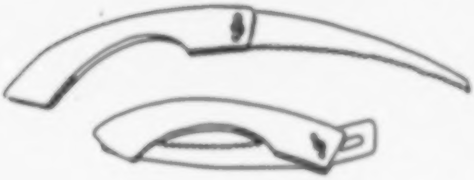
NOTE: Aluminum and fiber glass handles are available, but steel and wood are more durable.

- **pruning saw** – used to remove branches larger than 1¼ inch in diameter

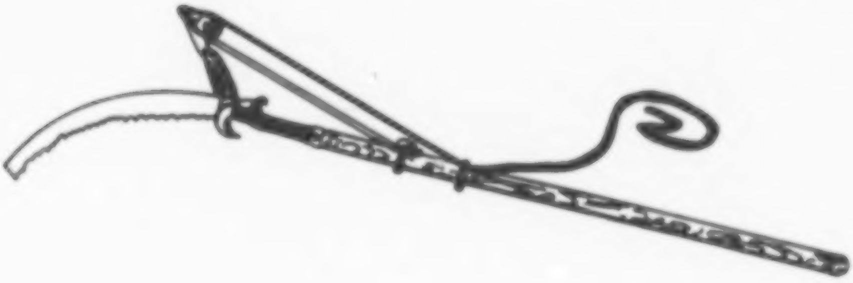


NOTE: Pruning saws may have double-edge blades with small teeth on one edge and larger teeth on the other for use on smaller or larger branches. Pruning saws are available in curved, straight blade, and folding models.

- **folding saw** — single-edge blade used for removing small-diameter tree limbs



- **pole pruner and saw** — used to remove branches that are out of reach



OBJECTIVE 3

Select from a list reasons for pruning fruit trees, nut trees, berry vines, and bushes.

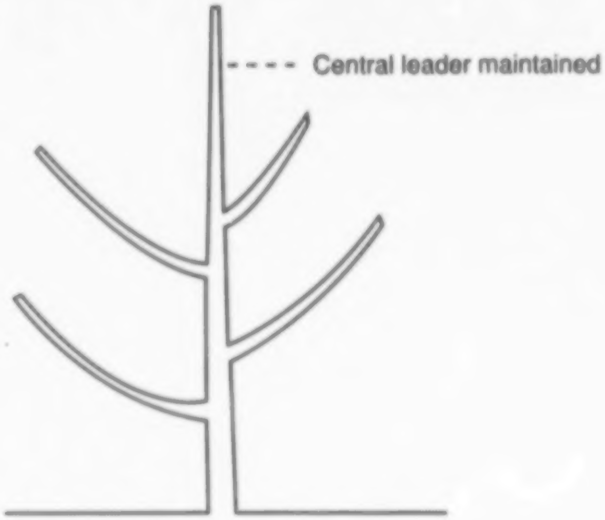
It is important not to **overprune** young trees, vines, and bushes, as this can delay fruit bearing from 1 to 3 years. In addition, **underpruning** can result in fruits of poor quality and color. Pruning fruit trees, nut trees, berry vines and bushes:

- Increases size of fruit
- Helps to control pests and diseases
- Gives vigor to fruiting wood
- Increases fruit color development
- Reduces plant size to keep it within space requirements

OBJECTIVE 4

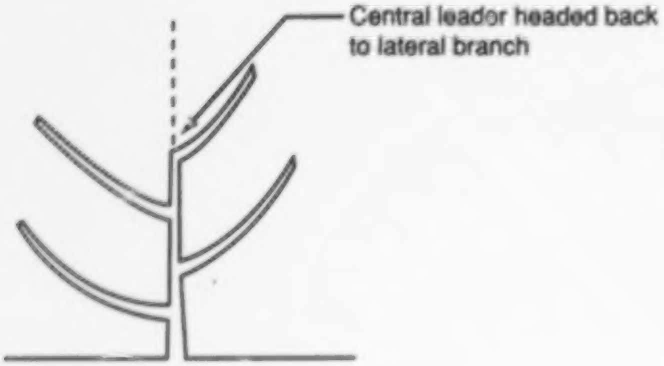
Describe the three methods of pruning fruit and nut trees.

- **Central leader** – Topmost branch, or central leader, is encouraged to be the dominant branch; results in pyramid-shaped tree



Central Leader

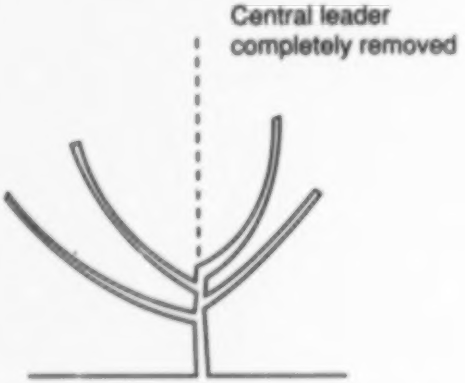
- **Modified central leader** – Central leader is encouraged to grow for several years, then headed back to a lateral branch


Central leador headed back to lateral branch

Modified central leader

- **Open center** – Central leader completely removed and center left open

  NOTE: If not properly pruned, the tree could become weak. Water pockets could form; heart rot could occur in the crotch; and heavy limb breakage could occur.


Central leader completely removed

Open center

OBJECTIVE 5 **Complete sentences describing pruning needs for various fruit and nut crops.**

Fruit trees are usually pruned in January, February, or early March. Since pruning can slightly reduced the winter hardiness of a tree, especially peach trees, it is best to wait as late as possible to prune.

Remember, it is best to properly prune trees when they are young so you do not have to make large cuts later in the tree's life. It is also better to remove some wood every year rather than severely pruning every three or four years.

- **Apples** – At planting, the tree should be headed at **30-36** inches, cutting the tree back by about **one-half**. Trees are generally trained to a central leader or **modified central leader**.
- **Pears** – Should be pruned similar to the **apple**, but may need more limb **spreading** because of the upright growth habits of the tree.
- **Peaches** – At planting, prune to a single upright stem, **24 to 36** inches. If the tree has wide-angled, strong lateral branches, select three spaced evenly in all directions on the trunk and separated by no more than six inches of trunk. Allow these to develop into an **open center** type tree.
- **Plums** – Training system is determined by the tree's growth pattern; most are trained to an **open center**, but European varieties conform better to a **modified central leader**.
- **Cherries** – At planting, cut back to **24 to 30** inches. Select three to five branches to form the primary framework of the tree; train to **open center**.
- **Pecans** – At planting, remove **one-half** of the long stem; train to form a **central leader** tree. This requires pinching lateral branches in first few years to force growth into main stem.
- **Blueberries** – Require pruning to thin out lower limbs to keep fruit from touching the ground; prune **dead branches** during dormant season; prune **annually**, especially to remove branches that rub each other and provide entry points for **disease**.

  NOTE: Plants should be pruned to a vase shape for mechanical harvest.

- **Blackberries** – Prune **annually** after harvest, removing the fruiting canes. Cut back non-fruiting or primocanes to **48** inches to boost lateral growth.

- **Strawberries** – Pruned every **year** after the fruit is picked in a **matted** row system. Excess runners are removed, the **foliage** of remaining plants is mowed off, and **broadleaf**-controlling herbicides are applied.

- **Grapes** – Allow vine to go untrained the first year, cut back to two buds before second year; select one **main shoot** and tie it to a stake. Generally, vines are topped to allow lateral branches to grow on wire **trellises**.

  NOTE: There are many types of trellis systems.

OBJECTIVE 6 **Describe the types of pollination requirements.**

- **Self-fruitful** – Will usually produce a commercial crop when planted in solid blocks

- **Partially self-fruitful** – Will self-pollinate, but requires cross-pollination to set a commercial crop

- **Self-unfruitful** – Requires cross-pollination to set a crop

  NOTE: Cross pollination means different varieties should be planted near each other.

OBJECTIVE 7 **Match various fruit trees, nut trees, and berries to their correct pollination methods.**

- **APPLES**

  - **Self-fruitful** – Yellow Transparent and Grimes Golden.

  - **Partly self-fruitful** – Ben Davis, Black Ben, Gano, Summer Champion, Lodi, and Rome Beauty; need cross pollination; Yellow Transparent considered a good pollinizer.

  - **Partly self-fruitful** – Jonathan, Blackjon, and Jonared; need cross-pollination; Golden Delicious, Starking, or York Imperial are good pollinizers.

  - **Self-unfruitful and pollen sterile** – Winesap, Turley, and Stayman Winesap. Good pollinizers for these varieties are Jonathan and Golden Delicious.

- **PEACHES AND NECTARINES**

  Most varieties considered self-fruitful, except for J.H. Hale peaches.

- **PEARS**

  Most varieties are partly self-fruitful, but produce better when two or more varieties are planted.

- **PECANS**

  Most varieties are considered partially self-fruitful, but produce better when more than one variety is planted.

- **PLUMS**

  Most Japanese varieties are self-unfruitful; European plums vary from self-fruitful to self-unfruitful.

- **CHERRIES**

  Sour cherries are self-fruitful and sweet cherries are self-unfruitful.

- **STRAWBERRIES**

  Recommended varieties for Oklahoma are self-fruitful.

- **BLACKBERRIES**

  Recommended varieties for Oklahoma are self-fruitful; Dallas variety requires cross-pollination.

- **GRAPES**

  Most varieties are self-fruitful and cross-compatible; America, Enda, Last Rose, and Brighton require cross pollination by other varieties.

  NOTE: Most grapes are wind-pollinized. Many muscadines are female only and need a pollinator.

- **BLUEBERRIES**

  Most varieties are self-fruitful, but are more productive if more than one variety is planted.

OBJECTIVE 8

List possible solutions to pollination problems.

- Apply nitrogen fertilizer three weeks before blooming for more plant vigor.
- Attach bouquet of flowers of suitable pollinizers to the trees or in a bucket of water below the trees.
- Add some bee colonies to the orchard.
- Graft or add new pollinizers.

NOTE: The last two solutions are best for commercial situations.

OBJECTIVE 9

Select from a list reasons for fruit thinning.

- Increases yields of marketable fruit
- Improves color
- Improves eating quality
- Reduces limb breakage
- Keeps trees vigorous
- Prevents alternate bearing
- Allows better penetration of dust and spray
- Reduces labor costs for picking
- Cuts down on handling, storing low-grade fruits

OBJECTIVE 10

Describe the three methods of thinning.

- **Chemical** — Chemicals are sprayed on blossoms or fruit at certain times to cause fruit to drop; blossoms or fruit must be thoroughly soaked.

NOTE: Chemical thinning can cost less than other methods because not as much labor is required. However, one spray has not been found to have the same results on all species. In addition, climate and other factors can affect spraying and the results. Chemical thinners are not generally recommended for peach trees.

- **Manual** – Fruits are thinned by hand by grasping the fruit and twisting it off or pinching it off; a pole with a rubber hose or wire attached may be used to hook the fruit and pull it off.

  NOTE: Hand-thinning is more costly than other methods because of the time and labor involved. However, workers can selectively discard fruits – those that are smaller and those with undesirable qualities such as disease and irregularities.

- **Mechanical** – A mechanical shaker has a clamp that encircles a main scaffold and uses hydraulic shaking action to knock fruit from the tree; tree may be damaged.

OBJECTIVE 11 **Match various types of fruits to their thinning requirements.**

- **Pears** – No hard and fast rule; experiments indicate that 30 to 40 good leaves per fruit are necessary.
- **Apples** – Thin to one fruit per spur spaced 4-6 inches apart; remove all fruit from leader.
- **Peaches, nectarines** – Leave one fruit every 6-8 inches.
- **Plums** – Thin 2 to 4 inches apart right after petals fall.
- **Grapes** – 3-year-old vines should be thinned to 8 to 12 clusters; 4-year-old vines to 16 to 24 clusters; and mature vines 40 to 80 clusters.

A Calendar for Pecan Growers

Glenn 'Cat' Taylor
Extension Horticulturist, Ret.

A complete, well-rounded cultural program is essential for the annual production of high quality pecan nuts. Such a program must satisfy four major needs: (1) adequate tree spacing, (2) sufficient soil moisture, (3) proper soil fertility, and (4) good pest control. When one or more of these factors is neglected, production is usually reduced.

Three or more years of optimum care to the trees are usually necessary before consistent annual cropping is realized. Some variety and native trees tend to produce more consistent crops than others.

Check the following calendar each month as a reminder to give your trees the care they need.

JANUARY

Improved Groves: Remove surplus trees if crowding occurs. Prune out damaged branches. Prune low branches that interfere with cultural operations.

Unimproved Groves: First year – remove all trees other than pecans. Second year – thin the remaining pecan trees to no more than 30 cross sectional square feet of trunk area per acre.

FEBRUARY

Fertilization: Apply fertilizers according to recommendations based on laboratory results of leaf samples collected during the past July. O.S.U. Fact Sheet #6232 gives details for using the leaf analysis program plus additional fertilization guidelines for both commercial and home ground trees

Control Rosette (Zinc Deficiency): If soil treatment will be used, apply zinc sulfate or zinc chelate.

To Start Trees From Non-Stratified Nuts: Soak large well-filled nuts from latest crop for two to three days and plant approximately three inches deep. Changing of water once or twice while soaking is helpful. Stratified nuts may be planted late March.

Cut & Store propagation Wood: Collect before growth begins. Do not allow scions to dry out. Store at 32°. For details see Fact Sheet #6217.

MARCH

Propagation Maintenance: Prune established grafts by selecting central leader and removing weak crotches.

Prepare For Pests: Purchase necessary pesticides for coming season. Service and repair sprayer.

Merchandising: Place remaining pecans in cold storage (32° F or below).

Plant Trees: Use freshly dug trees of adapted varieties or seedling trees grown in open-bottomed containers that use air-pruning to control the taproot. Dig hole large enough to accommodate root system. Prune taproot of bareroot trees to 20" long. Use water to settle soil around roots. Prune top one-third to one-half.

APRIL

Whip Graft: Whip graft small trees in early April. Procedures are given in Fact Sheet #6205.

Bark or 4-Flap Graft: Begin grafting three to five weeks after growth starts. This is usually late April in southern Oklahoma to early May in the northern part. These two grafting procedures are given in the Fact Sheet $6204 and #6206. Select trees in suitable locations. When livestock graze in grove, place grafts at least 6 or 7 feet above the ground.

Weed Control: Apply pre-emerge herbicides.

Insect Control: If phylloxera problems were present last year, spray when tree growth begins (bud-break to 2" shoot growth).

Control Rosette: As the leaves begin to unfold, apply foliar spray applications of zinc at the rate of 6 lbs of zinc sulfate (36%) per acre. This is equal to 2 lbs of 36% zinc sulfate in 100 gallons when 300 gallons of this spray mixture are applied per acre. Other commercial zinc materials are available and should be used according to label instructions, or at rates to supply equivalent amounts of zinc as recommended zinc sulfate rates.

Zinc may be included with the pesticide spray. One to three additional zinc application applied at two to three week intervals may be needed when rosette is a persistent problem.

Disease Control: Spray scab susceptible varieties when leaves are about one-half normal size, April 25th to May 10th. (Prepollination)

MAY

Continue Propagation: Finish bark and 4-flap grafting during the month. Suitable small trees may be patch budded if advanced growth makes it too late for whip grafting.

Casebearer: Monitor nutlets for case bearer eggs. May 10th to June 10th is the usual period to check in Oklahoma. Apply spray when most of eggs are showing pink and beginning to hatch.

Remove Cover Crop: Disc or mow areas not pastured.

Control Rosette: Add zinc to the pest sprays.

Disease Control: Continue scab spraying

JUNE

Insect Control: Continue monitoring nutlets for casebearer eggs. Ask your county Extension agent for casebearer spray dates. Check tree to determine need for aphid, caterpillar, and fall webworm control sprays. Put out shuckworm pheromone traps.

Conserve Moisture: Destroy cover crop. Control weeds by mowing, discing, or chemical application.

Maintain Grafts: Force last year's graft by removing new growth and limbs below graft. Attach stake for tying the graft. Control excessive growth of graft by pruning back to approximately 18 inches.

Disease Control: Continue scab spray applications on susceptible varieties. The fungicide may be included in insecticide sprays.

JULY

Fertilization: Collect leaf samples for laboratory analyses in order to determine amount of fertilizers to apply next February or March.

Conserve Moisture: Continue to control weeds.

Soil Drainage: Clean drainage ditches. Drain heavy soils as necessary.

Insect Control: Continue monitoring shuckworm pheromone traps. Replace them if necessary. Set out cone traps by mid-July to monitor for pecan weevil adult emergence. Observe carefully for aphids and second generation casebearer. Spray when necessary.

Disease Control: Continue spraying susceptible varieties for scab, especially in wet seasons.

AUGUST

Watch for Insect Damage: Continue monitoring shuckworm pheromone traps and cone traps. Check trees for signs of twig girdler, aphids, and caterpillars. Spray as required.

Soil Preparation: Prepare ground for harvesting. Keep vegetation mowed or graded short. If using clean cultivation, level ground and firm. Remove branches and other trash. Condition soil for cover crops.

SEPTEMBER

Tree Spacing: Mark undesirable trees for removal.

Final Soil Preparation for Harvest: Keep soil clean, cultivated, mowed or grazed. Cattle should be removed from orchard to allow time for droppings to break down before harvest. Locate markets.

Insect Control: Check cone traps for pecan weevil emergence and spray if necessary.

Disease Control: If early season scab control has been good, late season scab development will not affect the crop and does not require control.

Cover Crop: Test soil and apply needed fertilizers. Plant cover crop recommended by county Extension agent.

OCTOBER

Maintain Sodded Areas: Mow or graze sodded areas to improve harvesting.

Harvest Preparations: Service and repair equipment.

Pests: Post "No Trespassing" signs. Control bluejays, crows and squirrels with chemicals, exploders and other firearms. Wildlife control is most efficient when operated pre-harvest and during the first part of harvest season.

NOVEMBER

Harvest Early: Prevent fire damage to nuts on ground. Pick up nuts immediately to eliminate loss to pests and prevent deterioration of kernel quality. Aerate early harvested nuts and store in unheated rooms. Select and exhibit nuts in local show. Market pecans.

Pests: Continue bird control.

DECEMBER

Harvest, Store, Market Nuts: Complete harvest before January 1st if possible. Clean, grade and protect nuts from rodents. Continue to market pecans.

Stratify Nuts: Select well-filled, undamaged nuts to stratify. Follow directions in OSU Fact Sheet #6207.

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ASSIGNMENT SHEET 1

Development of:
READING SKILLS

- Introduce the assignment to the students by discussing why reading skills are important.

- Discuss with them the following skills which are relevant to this task:

  READING

  - Gaining factual information
  - Using in-book references

- If students have difficulty gaining factual information:

  - Suggest they read carefully, noting key words and ideas.
  - Instruct them to write questions about the topic before they start reading and to look for the answers as they read.
  - Suggest they use at least three resources so the key ideas are repeated in their reading.
  - Have them translate the information in a form that would be useful to them, such as an actual calendar, poster, or flow chart.

- If students have difficulty using in-book reference tools:

  - Identify the content of the supplement and have students discuss how the information can be used to complete the assignment sheet.
  - Encourage students to use bookmarks or other devices to mark in-book references used most often.
  - Explain to students that books are "random access" tools, meaning the information in them is accessible in any order. Compare books to items which are not random access such as cassette tapes or video films.
  - Review terms used in the supplement as needed.

ASSIGNMENT SHEET 1

MAINTAIN FRUIT AND NUT CROPS

V

Name ______________________ Score __________

OBJECTIVE 12

Match various procedures for pecan producers with the correct month of the year.

INTRODUCTION

Growers often need to follow a regular routine to maintain – that is, prune, thin, fertilize, control weeds and pests, and harvest – their crops. If any of these procedures are neglected, production could be reduced and trees could suffer. This exercise will give you an idea of what kinds of tasks must be done during the year for other crops, as well.

DIRECTIONS

Review Supplement 1, and match the following duties to the correct month of the year. Write the correct letters in the blanks.

Reading Comprehension Skills
- Gain factual information

Research and Reference Skills
- Use in-book references

_____ 1. January

_____ 2. February

_____ 3. March

_____ 4. April

_____ 5. May

_____ 6. June

_____ 7. July

_____ 8. August

_____ 9. September

_____ 10. October

_____ 11. November

_____ 12. December

a. Harvest, store, and market

b. Watch for insect damage

c. Fertilization analysis

d. Prune

e. Harvest preparation

f. Propagation maintenance

g. Maintain grafts

h. Check for casebearer eggs

i. Fertilize

j. Tree spacing

k. Harvest early

l. Whip graft

m. Spray for green bugs

n. Top trees

o. Control skunks

ASSIGNMENT ANSWERS

MAINTAIN FRUIT AND NUT CROPS

V

ASSIGNMENT SHEET 1

1. d
2. i
3. f
4. l
5. h
6. g
7. c
8. b
9. j
10. e
11. k
12. a

JOB SHEETS 1-3

Development of:
READING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely.
  - Have them read the instructions several times, noting the key words and ideas.
- If students have difficulty mastering a specific job task/procedure:
  - Emphasize that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

JOB SHEET 4

Development of:
READING SKILLS
MATHEMATICS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, mathematics, and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  MATHEMATICS

  - Using English & metric measures

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty using English and metric measures:
  - Review the units of measure being used.
  - Suggest that they look at a tape and review the actual units that they will be estimating.
  - Have them practice drawing a line on the board or pacing the distance they are to estimate and then have another student measure the distance to give them a concrete idea about the lengths of different units of measurement.
- For additional suggestions on teaching basic skills, refer to suggestions for Job Sheets 1-3.

JOB SHEET 1

MAINTAIN FRUIT AND NUT CROPS

V

OBJECTIVE 13 **Prune a one-year peach tree.**

TOOLS AND MATERIALS

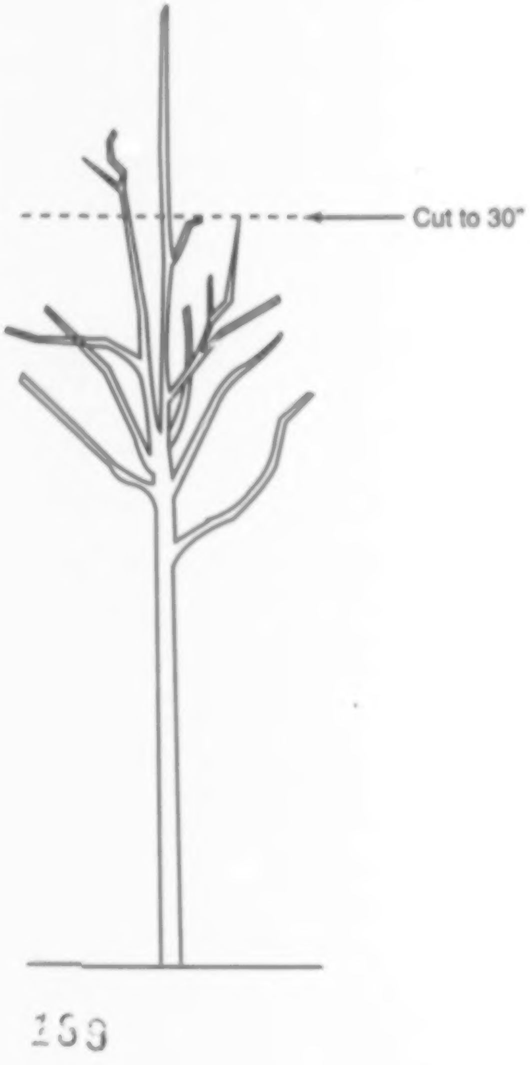
- Pruning knife or shears
- One-year tree

PROCEDURE

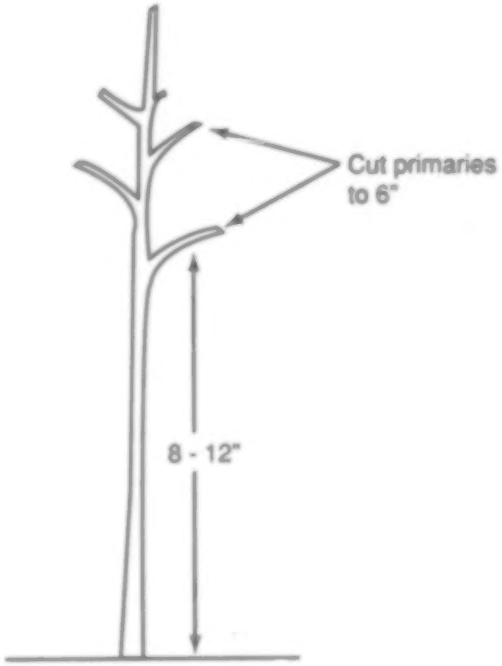
Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
1. Using shears or knife, cut back tree to about 30 inches high.	____	____



	Yes	No
2. Select your primary branches – about 3 or 4 of them, making sure they are evenly spaced around the trunk and about 8 to 12 inches apart.	____	____



	Yes	No
3. Make sure primary branches come out at a wide angle from the central leader; narrow-angle crotches can break easily.	____	____

NOTE: Pruning can be used to widen crotch area. Also, limbs may spread with the weight of fruit when it develops.

	Yes	No
4. Make sure bottom primary is about 8 to 12 inches from the ground. Remove all other lateral branches.	____	____
5. Stub the primary branches to about 6 inches.	____	____
6. Have instructor check your work.	____	____
7. Put away tools and materials and clean up work area.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Tree height	4	3	2	1
Selection of branches	4	3	2	1
Spacing of branches	4	3	2	1
Crotch angles of branches	4	3	2	1
Pruning of primary branches	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 2

MAINTAIN FRUIT AND NUT CROPS

V

OBJECTIVE 14 **Prune a two-year apple tree.**

TOOLS AND MATERIALS

- Pruning shears
- Two-year tree

PROCEDURE

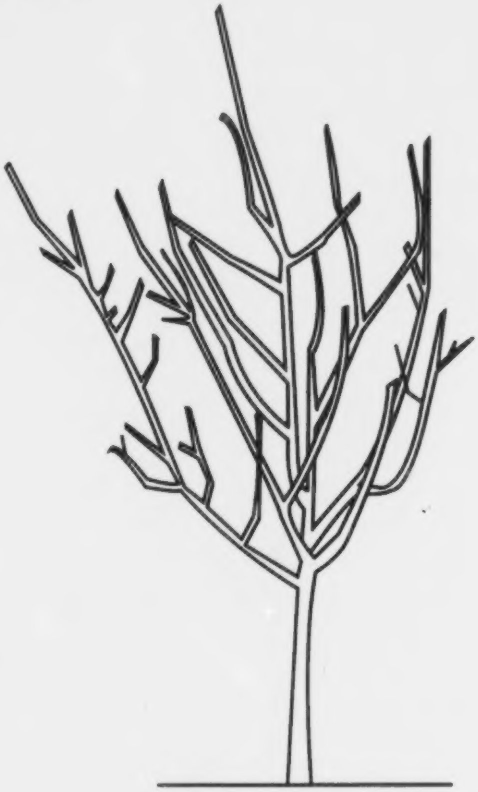
Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

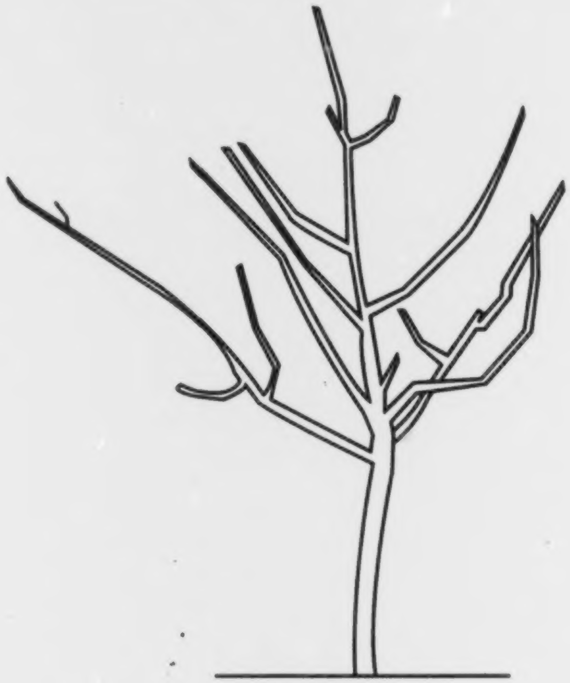
1. Select and cut back central leader. ____ ____

2. Select three to five primary scaffolds that are not directly above another scaffold. Thin out all other lateral branches. ____ ____



Yes No

3. Tip prune primary scaffolds and pinch sprouts growing upward from the lateral branches. Sprouts should not grow more than 12 inches long. ____ ____



4. Remove any water sprouts, branches growing into center of tree or crossing, or drooping branches. ____ ____

5. Have instructor check your work. ____ ____

7. Put away tools and clean up work area. ____ ____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Selection of central leader	4	3	2	1
Selection of scaffolds	4	3	2	1
Pruning of scaffolds and sprouts	4	3	2	1
Removal of poor branches	4	3	2	1
Placement of spreader	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** — Can perform job with no additional training
3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
1 **Unskilled** — Is familiar with process, but is unable to perform job

JOB SHEET 3

MAINTAIN FRUIT AND NUT CROPS

V

OBJECTIVE 15 **Spread branches on a fruit tree.**

TOOLS AND MATERIALS

- Spreaders

  NOTE: For first-year trees, clothespins can be used. For two- to three-year trees, spreaders can be made of metal rods, sharpened at both ends or slats of wood with metal spike or nails at either end.

- Tree with upright growing branches

PROCEDURE

Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
For one-year tree:		
1. Clamp closed end of clothespin onto main stem of tree, just above branch to be spread.	_____	_____
2. Allow shoot to come up between the clothespin "handles."	_____	_____
For two- to three year tree:		
3. Wedge metal rods or spikes between central leader or trunk and branch to be spread.	_____	_____
4. Have instructor check your work.	_____	_____
5. Put away tools and clean up work area.	_____	_____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Placement of clothespin	4	3	2	1
Placement of metal rods	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** — Can perform job with no additional training

3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required

2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill

1 **Unskilled** — Is familiar with process, but is unable to perform job

JOB SHEET 4 — MAINTAIN FRUIT AND NUT CROPS — V

OBJECTIVE 16

Construct trellis and prune grape vine using 4-cane kniffin system.

NOTE: This is only one system used for grape vine training. Others may be used depending on the grape variety and preferred harvest method. Contact your Extension Agent or grape growers in your area for other methods that may be used in your area.

TOOLS AND MATERIALS

- Wood posts (they may also be steel or concrete)
- Staples
- No. 10 or No. 12 galvanized wire
- Grape vines (second or third year vines)

PROCEDURE

Functional Reading Skills
- Follow written instructions

Math Application Skills
- Use English & metric measures

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

Constructing a trellis — Yes — No

1. Place the posts about 20 feet apart, making sure they are planted at least 1½ feet deep to keep them secure. ____ ____

2. Wrap the wire around the posts; the first wire should be about 42 inches from the ground; use staples to hold the wire to the posts. ____ ____

3. Place the second wire about 30 inches above the first wire, and secure it with staples. ____ ____

Pruning the vine

NOTE: After planting, the vine should be cut back to one cane – the strongest – and cut back to two buds.

4. Prune vine during the dormant season, choosing two strong canes at each wire level (four total). Cut each cane back to about six buds. ____ ____

Yes No

5. Prune the other canes, but leave four short canes, or spurs, beneath each of the primary canes you selected. Leave two buds on each of these spurs. _____ _____

NOTE: The spurs will become the fruiting canes for the following year's crop. The old arms will be removed.

6. Tie your primary canes, or arms, to the wires, directing one arm to the left and the other to the right. Tie them loosely to allow for growth. _____ _____

7. Have instructor check your work. _____ _____

8. Clean up work area and put away tools. _____ _____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Placement of stakes	4	3	2	1
Depth of posts	4	3	2	1

Placement of wire	4	3	2	1
Use of staples	4	3	2	1
Selection of canes	4	3	2	1
Number of buds left	4	3	2	1
Selection of spurs	4	3	2	1
Number of buds of spurs	4	3	2	1
Placement of ties	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

WRITTEN TEST

MAINTAIN FRUIT AND NUT CROPS

V

Name ______________________ Score __________

OBJECTIVE 1

Match terms associated with maintaining fruit and nut crops to their correct definitions. Write the letter of the correct answer in the blank.

_____ 1. Transfer of pollen grains from a male flower to the stigma of the female flower or pistil to set a crop of fruit

_____ 2. Second season canes on a blackberry plant, which die after fruiting (Formerly primocanes)

_____ 3. Process by which upright-growing branches are bent to a near horizontal position and held there

_____ 4. Producing a heavy crop one year, and little or no fruit the next year

_____ 5. A plant that takes two seasons to complete its life cycle, the first season for vegetative growth and the second for flowering and fruiting

_____ 6. New canes on a blackberry plant that are formed each season and produce flowers and fruit the following season

_____ 7. A tree with both male and female flowers

_____ 8. Removing young fruit from a tree or vine to produce a healthier crop and plant

_____ 9. To cut dead or living parts from a plant in order to increase fruit or flower production, to improve the form or to remove dead or diseased parts

a. monoecious
b. spreading
c. staking
d. perennial
e. pollination
f. primocanes
g. secondary canes
h. alternate bearing
i. biennial
j. floricanes
k. prune
l. wiring
m. thinning

May be photocopied for student use.

OBJECTIVE 2 **Match tools for pruning to their correct uses.** Write the correct letters in the blanks.

_____ 1. Used to remove branches larger than 1¼ inch in diameter

_____ 2. Used to remove branches that are out of reach

_____ 3. Single-edge blade used for removing small-diameter tree limbs

_____ 4. Used to prune small branches no larger than a pencil

_____ 5. Used for pruning branches from pencil-size to 1¼ inch in diameter

a. wire cutters

b. hand pruners

c. lopping shears

d. folding saw

e. hedge shears

f. dibble

g. pruning saw

h. pole pruner and saw

OBJECTIVE 3 **Select from a list reasons for pruning fruit trees, nut trees, berry vines and bushes.** Place an "X" in front of each correct answer.

_____ 1. Increases fruit color development

_____ 2. Halts fruit development

_____ 3. Reduces plant size to keep it within space requirements

_____ 4. Increases size of fruit

_____ 5. Reduces weeds

_____ 6. Helps to control pests and diseases

_____ 7. Gives vigor to fruiting wood

_____ 8. Ends need to fertilize plants

May be photocopied for student use.

OBJECTIVE 4

Describe the three methods of pruning fruit and nut trees. Write your description in the space provided.

Central leader – ____

____

____

Open center – ____

____

____

Modified central leader –________________________________

____

____

OBJECTIVE 5

Complete sentences describing pruning needs for various fruit and nut crops. Write the correct answer in the blanks.

1. Apple – At planting, the tree should be headed at ______________ inches, cutting the tree back by about __________________. Trees are generally trained to a central leader or ____________ ___________ __________.

2. Pears – Should be pruned similar to the ______________, but may need more limb ________________ because of the upright growth habits of the tree.

3. Peach – At planting, prune to a single upright stem, ______________ inches. If the tree has wide-angled, strong lateral branches, select 3 spaced evenly in all directions on the trunk and separated by no more than 6 inches of trunk. Allow these to develop into an _____________ ________________ type tree.

4. Plum – Training system is determined by the tree's growth pattern; most are trained to an _____________ __________________, but European varieties conform better to a __________________ ___________________ __________________.

May be photocopied for student use.

5. Cherry – At planting, cut back to ____________________ inches. Select three to five branches to form the primary framework of the tree; train to ______________ ______________.

6. Pecan – At planting, remove ___________________ of the long stem; train to form a ________________ __________________ tree. This requires pinching lateral branches in first few years to force growth into the main stem.

7. Blueberries – Require pruning to thin out lower limbs to keep fruit from touching the ground; prune ______________ _________________ during dormant season; prune __________________ to remove branches that rub each other and provide entry points for ____________________.

8. Blackberries – Prune __________________ after harvest, removing the fruiting canes. Cut back non-fruiting or primocanes to ____________________ inches to boost lateral growth.

9. Strawberries – Prune every ____________________ after the fruit is picked in a ____________________ row system. Excess runners are removed, the____________________ of remaining plants is mowed off, and ____________________-controlling herbicides are applied.

10. Grapes – Allow vine to go untrained ______________ ______________, cut back to two buds before second year; select one ______________ _______________ and tie it to a stake. Generally, vines are topped to allow lateral branches to grow on wire_________________.

OBJECTIVE 6 **Describe the types of pollination requirements.**

Self-fruitful – ____

____

____

Partially self-fruitful – ____________________________________

____

____

May be photocopied for student use.

Self-unfruitful – ______________________________

____

____

OBJECTIVE 7

Match various fruit trees, nut trees, and berries to their correct pollination methods. Write the correct letters in the blanks.

_____ 1. Yellow Transparent and Grimes Golden apples

_____ 2. Ben Davis, Black Ben, Gano, Summer Champion, Lodi, and Rome Beauty apples

_____ 3. Jonathan, Blackjon, and Jonared apples

_____ 4. Winesap, Turley, Stayman Winesap apples

_____ 5. Most varieties of peaches and nectarines, except for J.H. Hale peaches

_____ 6. Most pear varieties

_____ 7. Most varieties pecans

_____ 8. Japanese variety plums

_____ 9. Sour cherries

_____ 10. Sweet cherries

_____ 11. Strawberry varieties recommended for Oklahoma

_____ 12. Blackberry varieties recommended for Oklahoma

_____ 13. Most grape varieties

_____ 14. Most blueberry varieties

a. Self-fruitful

b. Partly self-fruitful

c. Self-unfruitful

May be photocopied for student use.

OBJECTIVE 8

List possible solutions to pollination problems. List three solutions in the blanks provided.

1. ______________________________

2. ______________________________

3. ______________________________

OBJECTIVE 9

Select from a list reasons for fruit thinning. Place an "X" in front of the each correct answer.

_____ 1. Lowers yields of marketable fruit

_____ 2. Improves eating quality

_____ 3. Keeps trees vigorous

_____ 4. Allows better penetration of dust and spray

_____ 5. Increases handling, storing low-grade fruits

_____ 6. Eliminates pruning

_____ 7. Reduces labor costs for picking

_____ 8. Improves color

_____ 9. Allows alternate bearing

OBJECTIVE 10

Describe the three methods of thinning. Write your answers in the space provided.

Chemical – ______________________________

____

____

____

Manual – ______________________________

____

____

____

May be photocopied for student use.

Mechanical – ______________________________

____

____

____

OBJECTIVE 11

Match various types of fruits to their thinning requirements. Write the correct letters in the blanks.

_____ 1. Thin 2 to 4 inches apart right after petals fall

_____ 2. 3-year vines should be thinned to 8 to 12 clusters; 4-year vines to 16 to 24 clusters; and mature vines 40 to 80 clusters

_____ 3. Thin to one fruit per spur spaced 4-6 inches apart; remove all fruit from leader

_____ 4. No hard and fast rule; experiments indicate that 30 to 40 good leaves per fruit are necessary

_____ 5. Leave one fruit every 6-8 inches

a. apples

b. pecans

c. pears

d. blackberries

e. peaches, nectarines

f. grapes

g. plums

NOTE: Objectives 12 - 16 are evaluated on assignment sheets/job sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

MAINTAIN FRUIT AND NUT CROPS

V

OBJECTIVE 1

1. e
2. j
3. b
4. h
5. i
6. f
7. a
8. m
9. k

OBJECTIVE 2

1. g
2. h
3. d
4. b
5. c

OBJECTIVE 3

1, 3, 4, 6, 7

OBJECTIVE 4

Answers should include the following:

Central leader – Topmost branch, or central leader, is encouraged to be the dominant branch; results in pyramid-shaped tree

Open center – Central leader completely removed and center left open

Modified central leader – Central leader is encouraged to grow for several years, then headed back to a lateral branch

OBJECTIVE 5

Answers should include:

1. 30-36, one-half, modified central leader
2. apple, spreading
3. 24-36, open center

4. open center, modified central leader
5. 24-30, open center
6. one-half, central leader
7. dead branches, annually, disease
8. annually, 48
9. year, matted, foliage, broadleaf
10. first year, main shoot, trellises

OBJECTIVE 6

Answers should include:

Self-fruitful – Will usually produce a commercial crop when planted in solid blocks

Partially self-fruitful – Will self-pollinate, but require cross-pollination to set a commercial crop

Self-unfruitful – Requires cross-pollination to set a crop

OBJECTIVE 7

1. a
2. b
3. b
4. c
5. a
6. b
7. b
8. c
9. a
10. c
11. a
12. a
13. a

OBJECTIVE 8

Answers should include any three of the following:

- Apply nitrogen fertilizer three weeks before blooming for more plant vigor.
- Add some bee colonies to the orchard.
- Attach bouquet of flowers of suitable pollinizers to the trees or in a bucket of water below the trees.
- Graft or add new pollinizers.

OBJECTIVE 9 2, 3, 4, 7, 8

OBJECTIVE 10 Answers should include:

Chemical – Chemicals are sprayed on blossoms or fruit at certain times to cause fruit to drop; blossoms or fruit must be thoroughly soaked.

Manual – Fruits are thinned by hand by grasping the fruit and twisting it off or pinching it off; a pole with a rubber hose or wire attached may be used to hook the fruit and pull it off.

Mechanical – A mechanical shaker has a clamp that encircles a main scaffold and uses hydraulic shaking action to knock fruit from the tree; tree may be damaged.

OBJECTIVE 11

1. g
2. f
3. a
4. c
5. e

OBJECTIVE SHEET

FERTILIZE FRUITS AND NUTS

VI

INTRODUCTION

Like people, plants require food or nutrients for growth. If plants are growing in infertile or nutrient-deficient soils, they can often get the additional nourishment they need from fertilizers. Without fertilization, trees and plants may produce poor fruit, show less growth, and become more susceptible to insect damage. It is important to know about the nutrients necessary for plant growth and how to determine which elements may be lacking. Remember, too much fertilizer can harm crops, too – causing limbs to break, delaying fruit ripening, and resulting in fruits that are soft and poorly colored.

UNIT OBJECTIVE

After completing this unit, the student will know the makeup of a complete fertilizer, understand the need for essential elements, secondary elements, and micronutrients, and be able to describe the methods of fertilizing fruit and nut crops. Also, the student will be able to analyze information on a fertilizer bag and be able to collect leaves for analysis. The student will demonstrate these competencies by completing an assignment sheet, job sheet and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with fertilizing fruits and nuts to their correct definitions.
2. Label components of a complete fertilizer formula (Guaranteed analysis).
3. Distinguish among values of essential elements nitrogen, phosphorus and potassium.
4. Match secondary elements to symptoms of deficiency.
5. Match micronutrients required for plant growth and development to symptoms of deficiency.
6. Describe methods used to detect fertilizer needs for fruits and nuts.
7. Describe types of commercial fertilizers.
8. State rules for storing fertilizer bags.

9. State regulations for handling fertilizers used in fruit and nut production.

10. Select from a list information required on a fertilizer bag.

11. Describe methods of applying fertilizer.

12. Match crops with proper fertilization times.

13. Complete sentences describing mulches used in small fruit production.

14. Analyze information required on fertilizer bags. (Assignment Sheet 1)

15. Collect leaf samples for analysis. (Job Sheet 1)

SUGGESTED ACTIVITIES

FERTILIZE FRUITS AND NUTS

VI

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with fertilizing fruits and nuts to their correct definitions.

Objective 2: Label components of a complete fertilizer formula (Guaranteed analysis).

- Discuss terms and definitions; use examples of different fertilizer types. Discuss "organic" vs. chemical fertilizers, and use examples.
- Discuss the common nitrogen-phosphorus-potassium combinations commonly used in fruit and nut production.

Objective 3: Distinguish among values of essential elements nitrogen, phosphorus and potassium.

Objective 4: Match secondary elements to symptoms of deficiency.

Objective 5: Match micronutrients required for plant growth and development to symptoms of deficiency.

- Compare the similarities between the nutritional needs of plants and those of humans. Discuss the "minimum daily requirements" of vitamins and minerals for people and compare those to the needs of plants.
- Have each student find out about one macronutrient and/or one micronutrient and give an oral report to the class.
- Ask students to look at plants on the school grounds or at home to try to identify deficiencies. Have them report their findings to the class.

Objective 6: Describe methods used to detect fertilizer needs for fruits and nuts.

- Bring in forms used by agricultural extension agencies to conduct leaf and soil analyses. Ask students to practice filling one out using samples obtained from home or school.
- Invite a "scout" who inspects orchards to discuss his or her job in identifying plant problems.

Objective 7: Describe types of commercial fertilizers.

- Show students examples of the various types of fertilizers. If possible, show how granular fertilizers are mixed to make a liquid form.

Objective 8: State rules for storing fertilizer bags.

Objective 9: State regulations for handling fertilizers used in fruit and nut production.

Objective 10: Select from a list information required on a fertilizer bag.

- Show students copies of state and federal regulations dealing with fertilizers.
- Give examples of what can happen when fertilizers are stored or used improperly or used improperly.

  EXAMPLE: Explosions, damage from inhalation.

- Let students see the MSDSs on fertilizers and chemicals used at your facility.
- Show students the information on fertilizer bags at your facility.

Objective 11: Describe methods of applying fertilizer.

- Show photographs of machinery used to spread fertilizers.
- Visit an orchard or field to see how fertilization is done on a large or small scale. Compare the techniques in terms of labor, cost, etc.

Objective 12: Match crops with proper fertilization times.

- Have students select a fruit or nut crop and design a program for that crop based on research.

Objective 13: Complete sentences describing mulches used in small fruit production.

- Describe organic and inorganic mulches.
- Go over benefits and drawbacks of using mulches on various crops.

APPLICATION

Objective 14: Analyze information required on fertilizer bags.

- Discuss the importance of leaf analysis in eliminating the "guess work" in fertility deficiencies.
- Have students complete Assignment Sheet 1.
- Invite your local agricultural extension agent to discuss how and where leaves are analyzed after the sample has been submitted.
- Send in a sample as a class project; discuss the results.

Objective 15: Collect leaf samples for analysis.

- Have students complete Job Sheet 1.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.

- Give the written test.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Taylor, Glenn, Gordon V. Johnson, and Michael W. Smith. "Fertilizing Pecan and Fruit Trees," OSU Extension Fact Sheet No. 6232, Cooperative Extension Service, Oklahoma State University, Stillwater, OK, n.d.

UNIT REFERENCES

Publications

- Childers, Norman F., *Modern Fruit Science*, Horticultural Publications: Gainesville, FL, 1983.
- *Fruits and Berries*, The American Horticultural Society: Mount Vernon, VA, 1982.
- *Introduction to Horticulture*, Unit 13: "Introduction to Fertilizers," Curriculum and Instructional Materials Center, State Department of Vocational and Technical Education: Stillwater, OK, 1989.

- McEachern, George Ray, *Growing Fruits, Berries & Nuts in the South*, Gulf Publishing Company: Houston, TX, 1978.

- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production*, Iowa Department of Public Instruction: Des Moines, IA, 1982.

- Reiley, Edward H., and Carroll L. Shry Jr., *Introductory Horticulture*, 3rd edition, Delmar Publishers Inc.: Albany, NY, 1988.

- Scheer, Arnold H., and Elwood M. Juergenson, *Approved Practices in Fruit and Vine Production*, The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

Pamphlets and other literature

- Taylor, Glenn, "Fertilizing Pecan and Fruit Trees," OSU Extension Fact Sheet No. 6232, Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

FERTILIZE FRUITS AND NUTS

OBJECTIVE 1

Match terms associated with fertilizing fruits and nuts to their correct definitions.

- **complete fertilizer** — fertilizer containing percentages of nitrogen, phosphorus, and potassium
- **foliar fertilizer** — nutrients are sprayed onto and absorbed through the leaves; especially effective in feeding plants micronutrients
- **incomplete fertilizer** — fertilizer containing percentages of only one or two of the three major nutrients (nitrogen, phosphorus, and potassium)
- **inorganic fertilizer** — fertilizer manufactured with chemicals
- **K_2O** — potassium in oxide form
- **macronutrient** — nutrient needed in large quantities for good plant growth
- **micronutrient** — nutrient needed in small quantities for good plant growth
- **mulch** — a material applied to the ground to reduce weed growth and water loss, and help keep soil temperature from wide fluctuations
- **NPK** — common name for the nutrient group of nitrogen, phosphorus, potassium

  NOTE: NPK is not the chemical notation. It is a shorter way of saying "Nitrogen, phosphorus, and potassium." The chemical notation is N, P_2O_5 and K_2O.

- **organic fertilizer** — naturally occurring fertilizer; usually animal or plant matter, also some minerals, and some human byproducts
- **P_2O_5** — phosphorus in oxide form

  NOTE: Phosphorus does not exist outside of a compound. It is always expressed as P_2O_5.

- **ppm** – parts per million
- **water soluble** – can be dissolved in water

OBJECTIVE 2 **Label components of a complete fertilizer formula (Guaranteed analysis).**

EXAMPLE: 10-20-10

10 = Nitrogen
20 = Phosphorus (expressed as P_2O_5)
10 = Potassium (expressed as K_2O)
40 = percent PLANT FOOD

- First number is percent nitrogen (N)
- Second number is percent phosphorus (P_2O_5)
- Third number is percent potassium (K_2O)

  NOTE: Also commonly referred to as potash.

- Sum of the numbers equals percent plant food

  NOTE: The remaining 60 percent of material is inert ingredients not contributing to nutritional value. This inert matter is called filler or carrier.

OBJECTIVE 3 **Distinguish among values of essential elements nitrogen, phosphorus and potassium.**

- **Nitrogen** – Produces leaf growth and dark green leaves. Deficiency causes leaves that are pale, yellow-green and smaller than normal; stunted, and usually small, shoots; blossoms may be abundant, but have a heavy drop, causing a poor crop; fruit may mature early, be small. Too much nitrogen may delay ripening, and cause poor color and fruit quality.

  NOTE: Nitrogen is the most important element in fertilizing and is needed more than any other to get maximum crops from trees and vines. However, trees and vines growing in soils that are already fertile will not benefit from additional fertilization.

- **Phosphorus** – Produces strong root systems and rapid growth. Deficiency causes stunted growth, dark or bronzed, thick leaves.

  NOTE: In experiments, trees grown in phosphate deficient soil produced well, while most annuals did not show normal growth.

- **Potassium** – Produces and matures seeds. It is essential for the production of protein and for all cell division and growth. Deficiency may cause leaf scorch and die-back, and sometimes burned or shriveled fruit. Leaf scorch limits the food intake through the leaves to the roots, reducing the efficiency of the root system.

  NOTE: Many fruits are good sources of potassium in our diets, so it is also important for good fruit and nut quality.

OBJECTIVE 4

Match secondary elements to symptoms of deficiency.

NOTE: Secondary elements are those usually found in sufficient amounts for plant growth, but are needed in extra amounts to provide good soil structure.

- **Calcium** – Needed by roots and shoots. Deficiency causes terminal buds to die at tips and causes leaves to die around the edges. Too much can reduce availability of iron and potassium.

  NOTE: Not a problem in many soils.

- **Magnesium** – Bottom leaves develop brownish blotches and fall off. Fruit buds may be greatly reduced.

  NOTE: Usually occurs in coastal areas.

- **Sulfur** – Deficiency causes leaves to turn yellow; reduced growth, fruit and quality. Has been used to help correct alkali soils and to lower pH for blueberries.

OBJECTIVE 5

Match micronutrients required for plant growth and development to symptoms of deficiency.

- **Manganese** – Yellowing occurs between veins on leaves; fruit yields reduced.

- **Iron** – Leaves near shoot tips turn yellow, some leaves may burn; reduced fruit yields, poor color and flavor.

  NOTE: This is particularly a problem in blueberries when soil pH is too high.

- **Boron** – Spotty areas on bark may enlarge, turn brown, and cover tips, causing leaves to die; fruit flesh may have brown, corky areas.

- **Zinc** – Tuft of small yellowish leaves develop at ends of shoots; fruits abnormal; reduced yields.

  NOTE: Zinc deficiency has also been called "little leaf," "rosette," or "corral sickness."

- **Copper** – Shoots die back; leaf scorch; early leaf drop; poor fruit production.

- **Molybdenum** – Deficiencies are rare; soil pH usually low; yellowing of tip leaves, and some scorching of lower leaves.

OBJECTIVE 6 **Describe methods used to detect fertilizer needs for fruits and nuts.**

- **Soil analysis** – Make sure the soil is taken near the roots of the tree or plant, and that it is representative of the entire orchard or field area. If the soil varies, make sure to get a sample from the various areas.

- **Leaf analysis** – A chemical analysis of the foliage of a fruit or nut tree can determine nutrient shortages or excesses even before the symptoms show up. It can also reveal which fertilizers may not be needed, and help cut costs. Leaf samples are usually analyzed for: nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron, and zinc.

  NOTE: This method is the most accurate.

- **Observation** – Look for visual symptoms, using the knowledge you have about mineral deficiencies and their symptoms. Check leaves for color, quantity and retention and shoots for length and diameter.

  NOTE: Be sure to look for other problems, such as rodent, disease or insect damage. Remember, not all problems can be solved with fertilization! Also, observation is best used in conjunction with the other methods mentioned.

OBJECTIVE 7 **Describe types of commercial fertilizers.**

- **Granular** – Small pelleted form of dry fertilizer; to be dissolved in water or foliar spray

- **Time-released** – Fertilizer designed for release over an extended period; available in quick, slow, and mid-release types; may be large pellets or prills (dry fertilizer core with water-soluble sulfur or plastic coating); is worked into soil, applied on top of soil, buried or dissolved in water; used in containers and outside plants; expensive

- **Water soluble** – Dry fertilizer is mixed with water and used in greenhouses; applied through injector systems or sprayers

OBJECTIVE 8 **State rules for storing fertilizer bags.**

NOTE: Fertilizer must be kept dry at all times. Moisture from condensation will seep into bags from concrete or other surfaces.

- Store in a dry area
- Store away from walls
- Store away from concrete floors; construct a wood rack to raise bags off ground
- Keep bags sealed

OBJECTIVE 9 **State regulations for handling fertilizers used in fruit and nut production.**

- In schools, fertilizers and all chemicals must be kept in a locked room and the location must be on file with the fire department.
- Store high nitrogen-content fertilizers in a separate area from complete fertilizers.

WARNING: High nitrogen-content fertilizers can explode. They should not be stored for any length of time. Storage instructions are on the bag and must be followed.

- Fertilizers containing herbicides are considered hazardous materials and must be stored in a locked room.

  NOTE: Fertilizers with herbicides are controlled under hazardous materials regulations by state and federal governments. Such fertilizers must be stored and handled as an herbicide and considered poisonous.

OBJECTIVE 10 **Select from a list information required on a fertilizer bag.**

NOTE: Below is a sample label containing the guaranteed analysis and all required information except storing and handling instructions.

GUARANTEED ANALYSIS

NET WEIGHT 25 POUNDS (11.34 Kg)

GREG'S PLANT-RITE SPECIAL 20-10-20

GUARANTEED ANALYSIS

TOTAL NITROGEN (N)..20%
  12.00% NITRATE NITROGEN
  8.00% AMMONIACAL NITROGEN
AVAILABLE PHOSPHORIC ACID (P_2O_5)...10%
SOLUBLE POTASH (K_2O)..20%

Primary Plant Nutrient Sources: Ammonium Nitrate, Ammonium Phosphate, Potassium, Nitrate

Potential Acidity 422 lbs. Calcium Carbonate Equivalent Per Ton.

Manufactured by: Greg's Fertilizer Products, Smithland's Industries, Inc. Stillwater OK 74074

- Name of fertilizer

  EXAMPLE: Brand name and/or chemical compound such as ammonium nitrate, urea, ammonium phosphate, potassium nitrate, fritted potash, nitric phosphate, etc.

- Guaranteed analysis lists all nutrients by name and chemical symbol and lists percentages of each

- Name and address of manufacturer

  NOTE: Manufacturer is obliged by law to provide Material Safety Data Sheets (MSDS) on request. The MSDS lists cautions, hazards, handling and storing requirements.

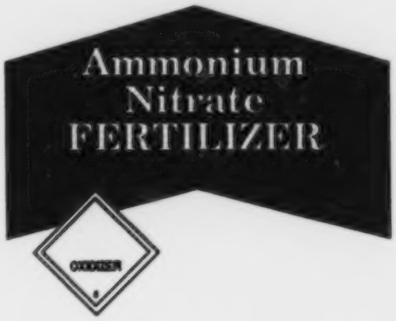
- Instructions for storing and handling

- Net weight

- Hazardous warning on potentially dangerous fertilizers

EXAMPLES: Hazard symbols are provided on all high-nitrogen-content fertilizers.

NOTE: "Oxidizer" means the fertilizer can explode. Safety procedures for storage, application, bag disposal and fires are also listed on the bag. The "Oxidizer" emblem is bright yellow.



OBJECTIVE 11 **Describe methods of applying fertilizer.**

- **Hand application** – Spread fertilizer around the tree one foot from the trunk to the outer edges of the branches (drip line).
- **Endgate distributors** – Use "twirlers" on the end of a truck or machinery to distribute the fertilizer under the trees; this method uses about 25 percent more fertilizer than hand application.
- **Pesticide dusters** – Use power dusters calibrated to apply fertilizer in half-moons under the trees as it moves up the rows.
- **Liquid application** – Use sprayers attached to machinery to spray fertilizer under trees; liquid fertilizer may also be drilled into the ground under the trees using tractor-mounted equipment or applied through appropriate irrigation systems.
- **Foliar application** – Apply zinc diluted with water to leaves or foliage of pecans, and some apples, in a uniform manner.

OBJECTIVE 12

Match crops with proper fertilization times.

Soil tests should be conducted before planting to determine what additions should be made to the soil before plants are put in the ground.

- **Fruit and nut trees** – Fertilize in April or May during the first year, then February or March the following years.
- **Grapes** – Fertilize in early spring with a complete fertilizer.
- **Blackberries** – Use a complete fertilizer in February or March before growth begins; apply again after fruiting and pruning.
- **Blueberries** – Apply a complete fertilizer that is acidic after buds start to swell; six weeks later apply ammonium sulfate if needed.
- **Strawberries** – After planting, apply fertilizers in late summer or early fall.

OBJECTIVE 13

Complete sentences describing mulches used in small fruit production.

Mulches can be used in most orchards and fields to control weeds and erosion, and conserve soil moisture. Use of mulches is most commonly recommended in strawberry and blueberry production.

- **Strawberries** – **Plastic** film is used as a mulch in hill systems; cuts are made in the **plastic** for plants to grow through. New **row covers** have also been developed to spread over the plants – they allow light and **moisture** to penetrate and no support is needed to hold them up off of the plants.

  NOTE: Organic mulches such as straw have also been used in strawberry fields for winter protection and to keep the berries off the ground, keep weeds down, and to provide a good surface for pickers to walk on.

- **Blueberries** – About **6** inches of mulch should be spread under the bushes and extend **2** feet from the crown of each plant to help acidify and cool the soil. Suitable mulches are **aged sawdust, wood chips, pine needles, shredded bark,** and **composted leaves.**

  NOTE: Remember, blueberries like acidic soil and therefore benefit from acidic mulches such as those suggested above. Grapes and blackberries can also benefit from mulches. Rodents, however, may become a problem.

ASSIGNMENT SHEET 1

Development of:
READING SKILLS
MATH SKILLS
SCIENCE SKILLS

- Introduce the assignment to the students by discussing why reading, math, and science skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Gaining factual information
  - Interpreting abbreviations/acronyms

  MATHEMATICS

  - Solving percent problems

  SCIENCE

  - Investigating/applying chemical properties

- If students have difficulty gaining factual information:
  - Suggest they read carefully, noting key words and ideas.
  - Instruct them to note the questions they must address before they start reading and to look for the answers as they read.
  - Suggest they use at least three resources (different labels) so they learn to look for the specific information required to use the product safely and correctly.
- If students have difficulty interpreting abbreviations/acronyms:
  - Review the terms and their concepts so that students hear, see, write, and say them.

  - Help students develop mnemonic devices for remembering N, P, and K.

    EXAMPLES:
    N for Nice Nitrogen
    P for Preposterous phosphorous
    K for the alKali in potassium

- If students have difficulty solving percent problems:
  - Remind students that percentages are fractions converted to decimal expressions.
  - Discuss the relationship of percentage to our decimal system.
  - Review the process for determining percentage: Smaller number (numerator) divided by the larger number (denominator).
  - Discuss common percentages and demonstrate how they are derived.
- If students have difficulty investigating/applying chemical properties:
  - Discuss the chemicals involved and the result of applying each to soil.
  - Discuss measurements of each and recommended levels for various crops.
  - Discuss and review safety procedures.

ASSIGNMENT SHEET 1

FERTILIZE FRUITS AND NUTS

VI

Name ____________________ Score ________

OBJECTIVE 14 **Analyze information required on fertilizer bags.**

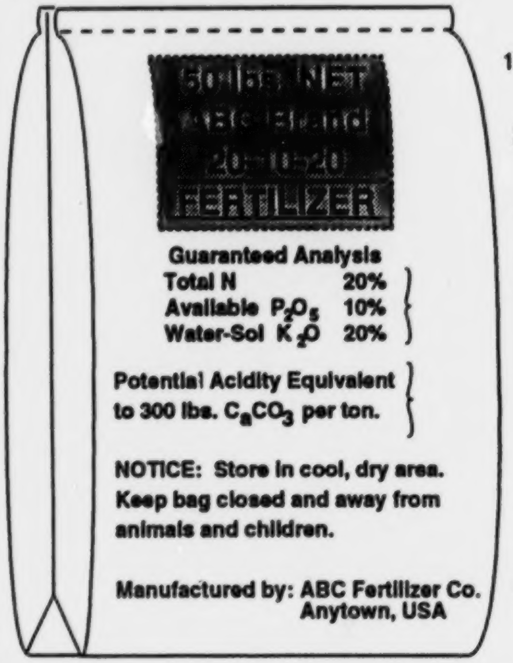
DIRECTIONS On the sample label below, items of information are numbered. Select the items that are required by law. Identify that item and then describe what each represents.

Reading Comprehension Skills
- Gain factual information

Functional Reading Skills
- Interpret abbreviations/acronyms

Math Application Skills
- Solve percent problems

Physical Science Skills
- Investigate/apply chemical properties



50 lbs. NET
ABC Brand
20-10-20
FERTILIZER

Guaranteed Analysis

Total N	**20%**
Available P_2O_5	**10%**
Water-Sol K_2O	**20%**

Potential Acidity Equivalent to 300 lbs. C_aCO_3 per ton.

NOTICE: Store in cool, dry area. Keep bag closed and away from animals and children.

Manufactured by: ABC Fertilizer Co.
Anytown, USA

1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________

In this 50 lb. bag, what percent of the 50 lbs. is:

9. Phosphorus _____
10. Nitrogen _____
11. Potassium _____
12. What is the percentage of plant food? _____
13. What is the percentage of filler? _____

ASSIGNMENT ANSWERS

FERTILIZING FRUITS AND NUTS

VI

ASSIGNMENT SHEET 1

1. Weight
2. Name of fertilizer
3. Components of fertilizer
4. Contents of package
5. Guaranteed analysis listing all nutrients by names and chemical symbol and percentages of each
6. Hazardous warning on potentially dangerous fertilizers
7. Instructions for storage and handling
8. Name and address of manufacturer
9. 10
10. 20
11. 20
12. 50
13. 50

JOB SHEET 1

Development of:
READING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely.
  - Have them read the instructions several times, noting the key words and ideas and procedure steps.
- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

  - Have students identify the stages they have trouble completing and what they can do to improve their performance.

- If students have difficulty practicing good work habits/attitudes:

  - Encourage them to become familiar with the entire procedure before they begin the work.

  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment.

  - Discuss what behaviors and attitudes constitute good work habits.

  - Make sure students know what is expected of them.

JOB SHEET 1

FERTILIZE FRUITS AND NUTS

VI

OBJECTIVE 15 **Collect leaf samples for analysis.**

TOOLS AND MATERIALS

- Sample bags
- Tap water
- Trees for leaf collection

INTRODUCTION

Leaf analysis is available through most extension services, which will provide sample bags and instructions. There is usually a nominal charge. Remember, the trees selected for each sample should be representative of the orchard or area. More than one sample may be needed if the landscape varies or if different management techniques are practiced. Only one variety or kind of fruit should be taken per sample. The following instructions apply primarily to apples, peaches and pecans. Samples must be collected in July.

PROCEDURE

Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

1. Inspect trees for injury from machinery, pests, cold, or too much water.

   NOTE: These factors could alter the nutritional levels of the tree.

2. Collect 100 leaves when sampling apple or peach trees; collect 100 leaflets on pecan trees.

3. Collect leaves from shoots that can be reached easily from the ground, and take them from different sides of the trees.

   NOTE: Do not collect leaves from suckers or water sprouts.

4. Do not collect more than 2 leaves from one shoot.

5. Choose apple and peach leaves from the middle of the current season's terminal growth.

6. Select the middle pair of pecan leaflets on a middle leaf of the current season's terminal growth.

   NOTE: Do not take leaves with insect, disease or machinery damage.

7. Remove leaves using a downward or backward pull so that the leaf stem stays attached to the leaf.

   NOTE: Do not use galvanized containers, rubber gloves, or allow leaves to touch rubber material; these could contaminate the sample.

8. Wash leaves before they wilt by dipping them in clear tap water for not more than 1 minute. Make sure spray residue and dirt is removed.

9. Spread the leaves out to air dry until they will crumble.

   NOTE: Make sure leaves are not in direct sunlight; do not dry them in a bag.

10. Place the dried leaves in a sample bag and submit them with a completed information sheet to your local extension center. Each sample should have a separate information sheet.

11. Put away tools and clean work area.

12. Have instructor check your work.

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Trees selected	4	3	2	1
Leaves selected	4	3	2	1
Removal of leaves	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

WRITTEN TEST

FERTILIZE FRUITS AND NUTS

VI

Name ______________________________ Score ___________

OBJECTIVE 1

Match terms associated with fertilizing fruits and nuts to their correct definitions. Write the correct letter in the blanks.

Part I

___ 1. Nutrients are sprayed onto and absorbed through the leaves; especially effective in feeding plants micronutrients

___ 2. Nutrient needed in large quantities for good plant growth

___ 3. Naturally occurring fertilizer; usually animal or plant matter, also some minerals, and some human byproducts

___ 4. Fertilizer containing percentages of only one or two of the three major nutrients (nitrogen, phosphorus and potassium)

___ 5. Fertilizer containing percentages of nitrogen, phosphorus, and potassium

___ 6. A material applied to the ground to reduce weed growth and water loss, and help keep soil temperature from wide fluctuations

___ 7. Common name for the nutrient group of nitrogen, phosphorus, potassium

a. Incomplete fertilizer

b. Insoluble

c. Complete fertilizer

d. Foliar fertilizer

e. Root fertilizer

f. Micro fertilizer

g. Organic fertilizer

h. Macronutrient

i. KPN

j. NPK

k. Mulch

May be photocopied for student use.

Part II

___ 1. Fertilizer manufactured with chemicals

___ 2. Nutrient needed in small quantities for good plant growth

___ 3. Potassium in oxide form

___ 4. Phosphorus in oxide form

___ 5. Can be dissolved in water

___ 6. Parts per million

a. P_2O_5

b. P_5O_2

c. Inorganic fertilizer

d. Water soluble

e. ppt

f. Micronutrient

g. ppm

h. K_2O

i. K_5O_3

OBJECTIVE 2 **Label components of a complete fertilizer formula (Guaranteed analysis).** Write the correct answer in the blank.

12 - 24 - 12 = 48%

1. ____________ 2. ____________ 3. ____________

4. What does the 48 percent mean? ______________________

OBJECTIVE 3 **Distinguish among values of essential elements nitrogen, phosphorus and potassium.** Write "N" in the blanks before statements that describe nitrogen, "P" in the blanks before statements that describe phosphorus, and "K" in the blanks before statements that describe potassium.

___ 1. Deficiency may cause leaf scorch and die-back, and sometimes burned or shriveled fruit.

___ 2. Too much may delay ripening, and cause poor color and fruit quality.

___ 3. Deficiency causes stunted growth, dark or bronzed, thick leaves.

___ 4. Deficiency causes leaves that are pale, yellow-green and smaller than normal.

___ 5. Produces leaf growth and dark green leaves.

___ 6. Produces strong root systems and rapid growth.

___ 7. Produces and matures seeds. It is essential for the production of protein and for all cell division and growth.

May be photocopied for student use.

OBJECTIVE 4

Match secondary elements to symptoms of deficiency. Write the correct letter in the blanks.

___ 1. Bottom leaves develop brownish blotches and fall off. Fruit buds may be greatly reduced.

___ 2. Needed by roots and shoots. Deficiency causes terminal buds to die at tips and causes leaves to die around the edges. Too much can reduce availability of iron and potassium.

___ 3. Leaves turn yellow; reduced growth, fruit and quality. Has been used to help correct alkali soils.

a. copper
b. sulfur
c. manganese
d. iron
e. magnesium
f. calcium

OBJECTIVE 5

Match micronutrients required for plant growth and development to symptoms of deficiency. Write the correct letter in the blanks.

___ 1. Spotty areas on bark may enlarge, turn brown, and cover tips, causing leaves to die; fruit flesh may have brown, corky areas.

___ 2. Shoots die back; leaf scorch; early leaf drop; poor fruit production.

___ 3. Deficiencies are rare; soil pH usually low; yellowing of tip leaves, and some scorching of lower leaves.

___ 4. Yellowing occurs between veins on leaves; fruit yields reduced.

___ 5. Tuft of small yellowish leaves develop at ends of shoots; fruits abnormal; reduced yields.

___ 6. Leaves near shoot tips turn yellow, some leaves may burn; reduced fruit yields, poor color and flavor.

a. copper
b. nitrate
c. molybdenum
d. zinc
e. potash
f. iron
g. chlorite
h. carbon
i. boron
j. manganese

May be photocopied for student use.

OBJECTIVE 6 **Describe methods used to detect fertilizer needs for fruits and nuts.** Write your answers in the blanks provided.

Soil analysis – ____________________

Leaf analysis – ____________________

Observation – ____________________

OBJECTIVE 7 **Describe types of commercial fertilizers.** Write your answers in the blanks provided.

Granular – ____________________

May be photocopied for student use.

Time-released – ______________________________

____

____

____

____

Water soluble – ______________________________

____

____

____

____

OBJECTIVE 8 **State rules for storing fertilizer bags.** List four rules.

1. ______________________________
____

2. ______________________________
____

3. ______________________________
____

4. ______________________________
____

May be photocopied for student use.

OBJECTIVE 9

State regulations for handling fertilizers used in fruit and nut production. List three regulations.

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

OBJECTIVE 10

Select from a list information required on a fertilizer bag. Place an "X" in the blank before each correct answer.

___ 1. Type of fertilizer, such as liquid, granular, pelleted, etc.

___ 2. Name and address of manufacturer

___ 3. Percentages of calcium and phosphorus

___ 4. Translation of instructions in Spanish

___ 5. Instructions for storing and handling

___ 6. Net weight

___ 7. Disclaimer by manufacturer for anyone misusing the fertilizer

___ 8. Guaranteed analysis lists all nutrients by name and chemical symbol and lists percentages of each

___ 9. Instructions on taking a soil sample

___ 10. Hazardous warning on potentially dangerous fertilizers

___ 11. Name of fertilizer

May be photocopied for student use.

OBJECTIVE 11

Describe methods of applying fertilizer.

1. Hand application – ______________________________
____

2. Endgate distributors – ____________________________
____

3. Pesticide dusters – ______________________________
____

4. Liquid application – _____________________________
____

5. Foliar application – ______________________________
____

OBJECTIVE 12

Match crops with proper fertilization times. Write the correct letter in the blank.

___ 1. Fertilize in early spring with a complete fertilizer.

___ 2. Use a complete fertilizer in February or March before growth begins; apply again after fruiting and pruning.

___ 3. After planting, apply fertilizers in late summer or early fall.

___ 4. Apply a complete fertilizer that is acidic after buds start to swell; six weeks later apply ammonium sulfate if needed.

___ 5. Fertilize in April or May during the first year, then February or March the following years.

a. Fruit and nut trees

b. Strawberries

c. Blackberries

d. Grapes

e. Blueberries

May be photocopied for student use.

OBJECTIVE 13 **Complete sentences describing mulches used in small fruit production.**

1. Strawberries – ______________________ film is used as a mulch in hill systems; cuts are made in the _______________ for plants to grow through. New _________________________ have also been developed to spread over the plants – they allow light and ___________________ to penetrate and no support is needed to hold them up off of the plants.

2. Blueberries – About _________inches of mulch should be spread under the bushes and extend _________ feet from the crown of each plant to help acidify and cool the soil. Suitable mulches are (name three)
____.

NOTE: Objectives 14-15 are evaluated on job sheets/assignment sheets in this unit. If you have not completed these components, see your instructor.

WRITTEN TEST ANSWERS

FERTILIZE FRUITS AND NUTS

VI

OBJECTIVE 1

Part I	Part II
1. d	1. c
2. h	2. f
3. g	3. h
4. a	4. a
5. c	5. d
6. k	6. g
7. j	

OBJECTIVE 2

1. Nitrogen
2. Phosphorus
3. Potassium
4. Percent plant food

OBJECTIVE 3

1. K
2. N
3. P
4. N
5. N
6. P
7. K

OBJECTIVE 4

1. e
2. f
3. b

OBJECTIVE 5

1. i
2. a
3. c
4. j
5. d
6. f

OBJECTIVE 6

Soil analysis – Make sure the soil is taken near the roots of the tree or plant, and that it is representative of the entire orchard or field area. If the soil varies, make sure to get a sample from the various areas.

Leaf analysis – A chemical analysis of the foliage of a fruit or nut tree can determine nutrient shortages or excesses even before the symptoms show up. It can also reveal which fertilizers may not be needed, and help cut costs. Leaf samples are usually analyzed for: nitrogen, phosphorus, potassium, calcium, magnesium, manganese, iron, and zinc.

Observation – Look for visual symptoms, using the knowledge you have about mineral deficiencies and their symptoms. Check leaves for color, quantity and retention and shoots for length and diameter.

OBJECTIVE 7

Granular – Small pelleted form of dry fertilizer; to be dissolved in water or foliar spray

Time-released – Fertilizer designed for release over an extended period; available in quick, slow, and mid-release types; may be large pellets or prills (dry fertilizer core with water-soluble sulfur or plastic coating); is worked into soil, applied on top of soil buried or dissolved in water; used in containers and outside plants; expensive

Water soluble – Dry fertilizer is mixed with water and used in greenhouses; applied through injector systems or sprayers

OBJECTIVE 8

Answers must include:

- Store in a dry area
- Store away from walls

- Store away from concrete floors; construct a wood rack to raise bags off ground
- Keep bags sealed

OBJECTIVE 9

Answers must include:

- In schools, fertilizers and all chemicals must be kept in a locked room and the location must be on file with the fire department.
- Store high nitrogen-content fertilizers in a separate area from complete fertilizers.
- Fertilizers containing herbicides are considered hazardous materials and must be stored in a locked room.

OBJECTIVE 10

2, 5, 6, 8, 10, 11

OBJECTIVE 11

1. Hand application – Spread fertilizer around the tree one foot from the trunk to the outer edges of the branches (drip line).
2. Endgate distributors – Use "twirlers" on the end of a truck or machinery to distribute the fertilizer under the trees; this method uses about 25 percent more fertilizer than hand application.
3. Pesticide dusters – Use power dusters calibrated to apply fertilizer in half-moons under the trees as it moves up the rows.
4. Liquid application – Use sprayers attached to machinery to spray fertilizer under trees; liquid fertilizer may also be drilled into the ground under the trees using tractor-mounted equipment or applied through appropriate irrigation systems.
5. Foliar application – Apply zinc diluted with water to leaves or foliage of pecans, and some apples, in a uniform manner.

OBJECTIVE 12

1. d
2. c
3. b
4. e
5. a

OBJECTIVE 13

1. plastic, plastic, row covers, moisture
2. 6, 2, any three of the following: aged sawdust, wood chips, pine needles, shredded bark, composted leaves

OBJECTIVE SHEET

IRRIGATE FRUIT AND NUT CROPS

VII

INTRODUCTION

Water is essential when growing fruit and nut crops. If that water doesn't come from rain, snow, or other natural means, then growers must irrigate. Irrigation is necessary for all fruit crops, but is usually not needed for established pecans. Prolonged drought can damage or kill trees and plants, therefore destroying crops. Irrigation must be considered even before planting an orchard or field. If irrigation is necessary, will the cost of the system and the water affect the cost of the crop? These factors must be taken into consideration. A good knowledge of irrigation practices is invaluable when determining whether to go into the fruit and nut production business. Remember, water has become a precious commodity throughout the country, making it more and more important to practice water conservation.

UNIT OBJECTIVE

After completing this unit, the student will know factors affecting water quality, be able to describe advantages and disadvantages of various methods of irrigation, describe methods used to determine when to irrigate crops, and know components of a drip irrigation system. In addition, the student will be able to measure water flow in a stream. The student will demonstrate these competencies by completing the job sheet and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with irrigating fruit and nut crops to their correct definitions.
2. List factors affecting water quality.
3. State advantages and disadvantages of the four methods of irrigation.
4. Select from a list sources of water supply.
5. Match methods used to determine when to irrigate crops to their correct descriptions.
6. Complete sentences describing irrigation needs for various fruit and nut crops.
7. Label components of a drip irrigation system.

8. Match minimum drip irrigation water requirements to various mature, bearing fruit and nut crops.

9. Measure water flow in a stream. (Job Sheet 1)

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply the guest speaker with the Objective Sheet, Information Sheet, and any other components you want them to cover.

- Collect pieces of irrigation equipment and pictures of the various types of irrigation.
- Plan a field trip to an orchard, vineyard or field where irrigation is practiced.
- Arrange for use of all equipment and supplies needed to complete the job sheet.

DELIVERY

Objective 1: Match terms associated with irrigating fruit and nut crops to their correct definitions.

- Go over terms; use examples whenever possible.

Objective 2: List factors affecting water quality.

- Show examples of poor quality water; discuss what areas around you might have poor water quality.

- Discuss how to improve water quality, for example, by using filters.

- Discuss the use of recycled water, if feasible.

- Send in a water sample from your area to a county extension office for analysis; discuss the results.

Objective 3: State advantages and disadvantages of the four methods of irrigation.

- Show examples, such as illustrations, of the various methods of irrigation.

- Discuss water conservation and its growing importance around the county; ask students if they can remember times of drought and what happened during that period.

- Talk to or visit growers who use the various methods of irrigation; have them talk about the pros and cons of that technique.

- Have students explore the costs of the various methods.

Objective 4: Select from a list sources of water supply.

- Show examples of the various water supply sources; discuss which ones are most often tapped in your area.

- Invite a representative of a well-drilling company to visit your class to discuss the costs and risks of well digging.

- Contact state and federal agencies for copies of water rights and regulations that apply to growers in your area; discuss these with the class.

Objective 5: Match methods used to determine when to irrigate crops to their correct definitions.

- Show examples of equipment that measure moisture in the soil.

- Discuss the importance of keeping records on water use — and rainfall.

Objective 6: Complete sentences describing irrigation needs for various fruit and nut crops.

- Discuss irrigation needs of various fruit and nut crops; discuss the specific water needs in your area. These may be available from county agricultural extension agents.

- Have each student pick a town or area and a specific crop to grow; then have them research the rainfall records for that area and determine how much additional water might be needed to support that crop.
- Explore areas where crops could be grown without irrigation.

Objectives 7: Label components of a drip irrigation system.

Objective 8: Match minimum drip irrigation water requirements to various mature, bearing fruit and nut crops.

- Go over parts of the drip irrigation system; discuss what types of pipe might be used to guard against rodent or insect damage; show examples of the various types of pipe.
- Invite an irrigation specialist to speak to the class about installing an irrigation system.
- Discuss how much water can be saved using a drip system as opposed to flooding, furrows, or aerial methods.

APPLICATION

Objective 9: Measure water flow in a stream.

- Discuss the importance of determining how much water you can expect from your supply source. Talk about other measuring devices to calculate water flow, such as gauges in wells.
- Have students practice Job Sheet 1. If it is not handy to take students to a stream, give them the necessary calculations for stream width, depth, and flow, and let them calculate gallons per minute based on those figures.
- Have students complete Job Sheet 1.
- Use results obtained from Job Sheet 1 to determine if that stream can provide an adequate amount of water to an orchard or field.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.

- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test the actions listed in the specific objectives.
- Give written test.
- Reteach and retest if necessary.
- Complete appropriate section of competency profiles.
- Review individual and group performance to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications: Gainesville, FL, 1983.
- Gallot, Jim. "Planting and Early Care of the Peach Orchard," Fact Sheet No. 6244. Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.
- "Importance and Methods of Irrigation," Plant Science, No. 8069. Instructional Materials Service: Texas A&M University: College Station, TX, 1987.
- *Landscape Management: Field Specialist.* Mid-America Vocational Curriculum Consortium: Stillwater, OK, 1988.
- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing CO: Houston, TX, 1978.

- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction: Des Moines, IA, 1982.
- Reiley, Edward H. and Carroll L. Shry Jr. *Introductory Horticulture,* 3rd edition. Delmar Publishers Inc.: Albany, NY, 1988.
- Scheer, Arnold H. and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

UNIT REFERENCES

- Childers, Norman F. *Modern Fruit Science.* Horticulture Publications: Gainesville, FL, 1983.
- Gallot, Jim. "Planting and Early Care of the Peach Orchard," Fact Sheet No. 6244. Oklahoma State University Cooperative Extension Service: Stillwater, OK, n.d.
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- Scheer, Arnold H. and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

OBJECTIVE 1 **Match terms associated with irrigating fruit and nut crops to their correct definitions.**

- **aquifer** – underground layer of porous rock, sand, etc. containing water, into which wells can be sunk
- **evaporation** – water loss as a vapor
- **field capacity** – amount of water a soil will hold after drainage

  NOTE: Each soil particle is surrounded by water at field capacity, but most of it is held in wedges between the soil particles where they touch each other.

- **irrigation** – application of supplemental water
- **PSI** – pounds per square inch; a unit for measuring pressure
- **runoff** – surface flow of water from an area
- **slope** – incline of the surface of a soil
- **soil permeability** – quality of soil that enables water or air to move through it
- **water** – H_20; up to 85 percent of a plant's fresh weight

OBJECTIVE 2 **List factors affecting water quality.**

- Presence of suspended particles

  EXAMPLES: Sand, soil, algae

- Presence of chemicals

  EXAMPLES: Chlorine, water softeners, industrial waste

- High soluble salts or high sodium concentrations

  NOTE: Salts make it difficult for plants to extract the moisture from soil. It is especially important for blueberries to have low-salt water.

- High or low pH

  NOTE: Irrigation water quality is obtained from water quality analyses. These analyses can be done through your county extension office.

OBJECTIVE 3

State advantages and disadvantages of the four methods of irrigation.

NOTE: Methods of irrigating soils will depend on the amount of water you have available, on topography, soil, climate, and irrigation practices in your area.

- **Surface** – Water conveyed directly over area

  EXAMPLE: Flood irrigation

  Advantages:

  - Small power requirement
  - Less water evaporation
  - Aids in establishing root-soil contact in new plantings

  Disadvantages:

  - Very inefficient water use
  - Uneven water distribution
  - Compacts soil
  - High manual labor required for constant monitoring and moving equipment
  - May require special land preparation (such as drains and leveling to prevent erosion)

- **Subsurface** – Water released underground to move upward to plant roots

  Advantages:

  - Minimal evaporative loss from soil
  - Promotes deep rooting
  - May be used as drain system during excessive rainfall

  Disadvantages:

  - Land must be level or evenly sloped
  - Water movement is uneven
  - Visual inspection of distribution system is very limited
  - Excessive rainfall can upset application balance
  - Salts can accumulate at soil surface

- **Aerial (sprinkler)** – Water under pressure released into the air

  Advantages:

  - Both small and large systems available
  - Portable and permanent systems available
  - Adaptable to uneven terrain
  - Various delivery rates available

  Disadvantages

  - High evaporative loss
  - High cost of equipment
  - High power requirement
  - Uneven water distribution under windy conditions

- **Trickle or Drip** – Frequent, slow water application directly to the soil near individual plants through small pipes, tubes, and/or emitters

  Advantages:

  - Conserves water because of less evaporation, and water is directed to plants
  - Small power requirement
  - Aids weed control
  - Can be automated
  - Can be adapted to variable terrain and plant materials

  Disadvantages:

  - High maintenance and installation costs
  - Requires clean water source or filtering system
  - Distribution pipes may be attacked by pests such as rabbits, deer, foxes, and ants

OBJECTIVE 4

Select from a list sources of water supply.

NOTE: Check rain tables for your area to determine when and how much rainfall can be anticipated during the year and during the critical growing season.

- **Year-round rivers and streams** – Many are fed by rain, springs, or snow melt.

- **Reservoirs, lakes, and ponds** – Holding areas for water from rainfall and drainage. Water use may be restricted by rainfall, type of irrigation system, and limits on water use.

- **Canals and pipelines** – Water supply usually is controlled by a water control agency.

- **Wells** – A dependable, and usually inexpensive water source; however, growers must consider the problem of draining aquifers that supply water.

  NOTE: Growers need to contact state and federal water agencies regarding water rights before deciding to grow a crop. Water use may be limited or costly, making it undesirable to plant certain fruit or nut crops.

OBJECTIVE 5

Match methods used to determine when to irrigate crops to their correct descriptions.

- **Observation** – In fruit crops, wilted leaves will indicate a need for water. By this time, however, fruit growth may already be retarded, so continuous soil moisture tests are recommended.

- **Tensiometer** – An instrument that measures the availability of water held by the soil, no matter what the soil type; placed in the root zone of the plants.

- **Atmometer** – An instrument that estimates water loss from the soil by measuring the amount of water that evaporates from the atmometer.

- **Soil samples** – Samples are taken from various depths and locations using a soil tube or auger. The samples are then dried in an oven and weighed to calculate moisture content; method can be time-consuming.

- **"Feel test"** – Soil samples are taken using a soil tube or auger. Then a handful of the soil is squeezed firmly and compared with a soil moisture and texture guide.

OBJECTIVE 6

Complete sentences describing irrigation needs for various fruit and nut crops.

NOTE: Methods of irrigation must take into consideration soil conditions, grade of the land, size of water supply, and other factors.

- **Strawberries** – Use **sprinkle** or **aerial** irrigation at planting (a good rain is best!); then use flood or **drip** irrigation the remainder of the year.

- **Blueberries** – **Drip** irrigation; **about 1/2 gallon** a day per plant the first year, increased in following years. Should not exceed **five gallons** per plant a day.

- **Blackberries** – **drip** irrigation; fruit requires about **two** inches of water every two weeks for best fruit size.

- **Grapes** – **drip** irrigation lines attached to a low **trellis** wire are best. The amount of water needed depends largely on **location** (rainfall, soil texture, wind, and temperature).

  NOTE: Automatic "misting" of vineyards has been used in the West to reduce the need for irrigation water and to cool the grapes. This has helped increase yield and quality.

- **Peaches and nectarines** – **drip** or **"trickle"** irrigation; trees need about one inch of rain per week during the growing season, and **two** inches of rain per week during July and August.

- **Pears** – Trees are fairly **drought-tolerant**, but bigger crops can be obtained through irrigation; **overhead sprinklers** are sometimes used.

- **Apples** – Consider irrigation if trees are producing less than **eight** to **ten** inches annual terminal growth and producing small, poor quality fruit; surface watering through **furrows** is used in the West.

- **Plums** – Irrigation is most common in the **West** through furrows, flooding, or **trickle** irrigation.

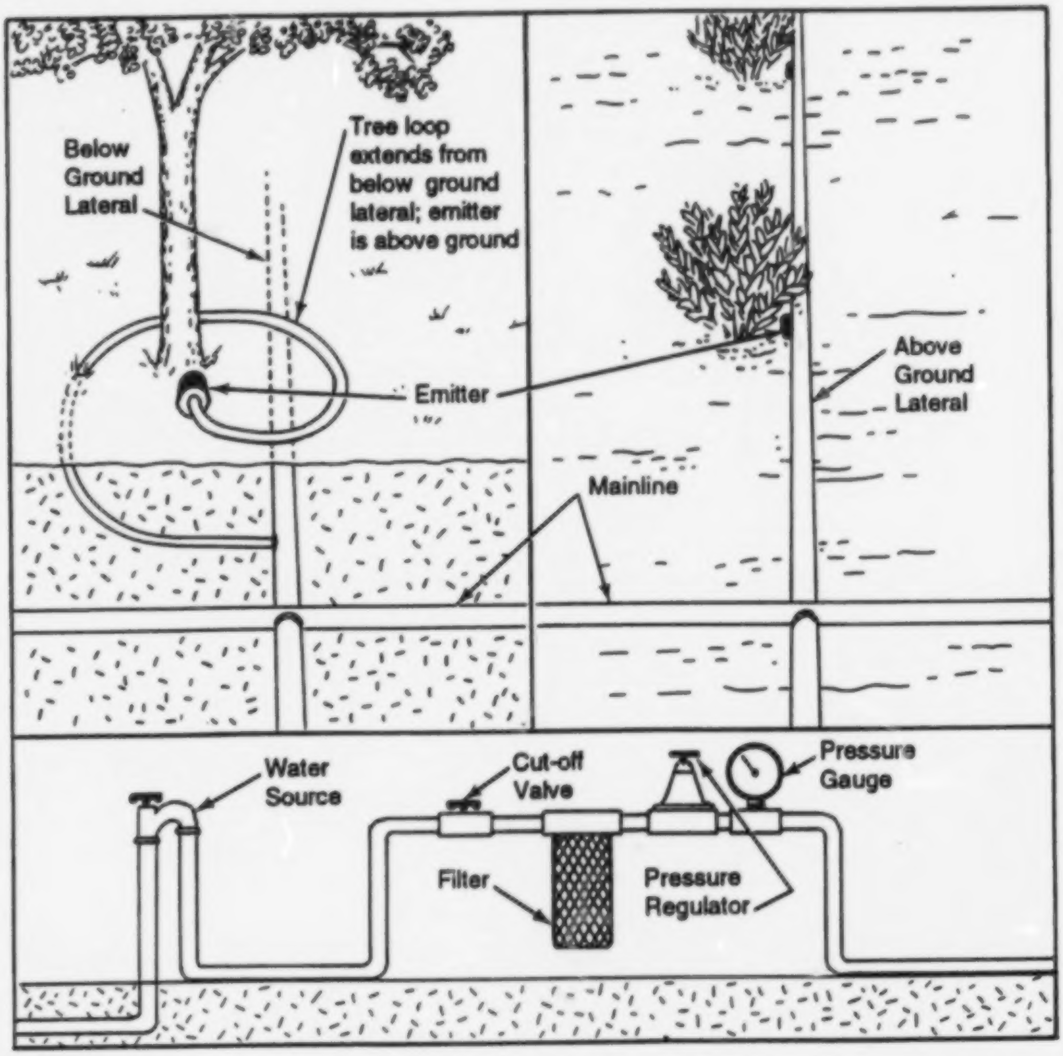
- **Cherries** – Irrigation rarely practiced in the East since fruits usually mature early in the season before loss of **soil moisture** is a problem.

  NOTE: Irrigation may be a regular practice in the West.

- **Pecans** – **Salt burn** can be a problem in the Southwest on trees irrigated with aerial sprinklers; **drip** irrigation is preferred.

OBJECTIVE 7 **Label components of a drip irrigation system.**

Drip irrigation is quickly becoming the preferred method of supplying water to fields and orchards because it helps conserve water. The system should be installed before trees are planted.


Below Ground Lateral
Tree loop extends from below ground lateral; emitter is above ground
Emitter
Above Ground Lateral
Mainline
Water Source
Cut-off Valve
Pressure Gauge
Filter
Pressure Regulator

NOTE: Tree loop may also be made of porous tubing so no emitter is used.

OBJECTIVE 8 **Match minimum drip irrigation water requirements to various mature, bearing fruit and nut crops.**

MINIMUM DRIP IRRIGATION WATER REQUIREMENTS

CROP	GALLONS PER DAY
Pecans	30
Peaches	15
Apples	15
Pears	15
Sour Cherries	15
Plums	10
Blueberries	13
Grapes	5
Blackberries	6.5
Strawberries	9.5

JOB SHEET 1

Development of:
READING SKILLS
MATHEMATICS SKILLS
SCIENCE SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, mathematics, science, and employability skills are important.

- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  MATHEMATICS

  - Calculating with whole numbers
  - Calculating with fractions
  - Calculating with decimals
  - Converting units of measure
  - Selecting/applying mathematical procedure
  - Using English & metric measures
  - Solving time/rate/distance problems
  - Collecting/recording data
  - Making measurements
  - Solving practical problems

  SCIENCE

  - Investigating conservation of physical resources

EMPLOYABILITY

- Mastering a specific job task/procedure
- Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely.
  - Have them read the instructions several times, noting the key words and ideas.
  - Go through a similar problem step-by-step so students will be prepared for the complexity of this job sheet.
  - Divide the job sheet into sections and check their progress so errors don't carry through from one step to the next.
- If students have difficulty calculating with whole numbers:
  - Review basic skills in addition, subtraction, multiplication, and division.
  - Review mathematical terminology.
  - Review principles of carrying in addition and borrowing in subtraction.

  NOTE: Information and assignment sheets with practice problems are available in *Whole Numbers*, part of the CIMC mathematics series. See also the Applied Mathematics Videos
- If students have difficulty calculating with fractions:
  - Demonstrate how a fraction is a part of the whole.
  - Review numerators and denominators and how to find the common denominator.
  - Demonstrate how to divide the numerator by the denominator to find percentage.
  - Have students practice converting, adding, subtracting, multiplying, dividing fractions.

  NOTE: Information sheet and assignment sheets with practice problems are available in *Fractions*, part of the CIMC mathematics series.

- If students have difficulty calculating with decimals:
    - Explain the fact that the decimal system is based on groups of ten.
    - Remind them that our money system is a decimal money system.
    - Review addition, subtraction, multiplication, and division skills using decimals.
    - Demonstrate how to divide to determine their decimal equivalents.

      NOTE: Information sheet and assignment sheets with practice problems are available in *Decimals and Percents*, part of the CIMC mathematics series.
- If students have difficulty converting units of measure:
    - Stress that all quantities or distances in a problem must be expressed in *like terms*. We cannot perform any mathematical operations with unlike terms such as quarts and gallons. They must be converted.
    - Explain that conversion is either a multiplication or division problem. With simple problems it is faster and easier to convert from smaller units to larger units.

      Students should divide to convert from smaller units to larger units:

      EXAMPLE: Convert 32 quarts to gallons: 32 ÷ 4 = 8 gals

      Students should multiply to convert larger units to smaller units:

      EXAMPLE: Convert 8 gallon to quarts: 8 x 4 = 32 quarts
    - Provide conversion tables and practice problems.

      NOTE: The CIMC *Forestry* curriculum has a supplement on conversion factors and an assignment sheet on converting units of measure. See Unit VIII, Assignment Sheet 1.
- If students have difficulty selecting and applying math procedures:
    - Instruct the students to reword the problem in a form that is clearer to them.

  - Review the mathematical procedures that are relevant to this assignment.

  - Review mathematical terminology.

- If students have difficulty using English and metric measures or measuring,

  - Review the units of measure and used in this assignment sheet and how they are divided.

  - Have students look at the units and compare them with each other until they have a concrete idea about the lengths and sizes of different units of measurement.

    EXAMPLE: Linear foot, square foot, and cubic foot

  - Demonstrate the correct way to measure using the specific measuring instruments.

  - Have students identify precisely what is being measured and why.

  - Allow students to watch more proficient students performing the measurement.

- If students have difficulty solving time/rate/distance problems:

  - Demonstrate the process described in steps 9 and 10, reviewing how to find the number of feet per second.

  - Suggest they construct a simple chart to help them visualize the problem. Since these are also problems of time/rate/volume an example might be:

EXAMPLE:

TIME	RATE	VOLUME
1 minute	2.2 ft^3/min	2.2 ft^3
15 minutes	2.2 ft^3/min	33 ft^3
2 hrs	2.2 ft^3/min	264 ft^3

  - Instruct them to examine the relationships between time and rate, rate and distance or volume, and time and distance or volume.

  - Discuss the fact that this is a skill that is used daily in life.

- If students have difficulty collecting and recording data:

  - Stress the importance of accuracy in recording data.

  - Remind them to keep careful notes and to double-check their calculations.
  - Stress that several measurements must be made at different locations to determine an average. Specify the minimum number of measurements.

- If students have difficulty solving practical problems:
  - Discuss the importance of having this information to irrigation practices.
  - Have students discuss the consequences of NOT knowing the water flow.
  - Discuss other applications of knowing the water flow and their importance to today's society.

- If students have difficulty investigating conservation of physical resources:
  - Define "physical resources" and discuss why conservation of irrigation water is part of this assignment.
  - Discuss the importance of conserving water.
  - Discuss the importance of having knowledge about the water and its uses and conservation.
  - Discuss ways in which the use of water affects the people living in a certain locale.

- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.

- Discuss the role that good work habits and attitudes have in obtaining and retaining employment.
- Discuss what behaviors and attitudes constitute good work habits.
- Make sure the student knows what is expected of him or her.

JOB SHEET 1 — IRRIGATE FRUIT AND NUT CROPS — VII

OBJECTIVE 9

Measure water flow in a stream.

INTRODUCTION

It is important to know how much water is flowing from a water source to make sure there is enough water for the crop and to determine how much water is reaching the trees or plants. Water can be measured in gallons per minute, acre inches per hour, or cubic feet per second. Growers usually deal with water in terms of acre feet – one acre foot of water is the amount of water needed to cover one acre one foot deep.

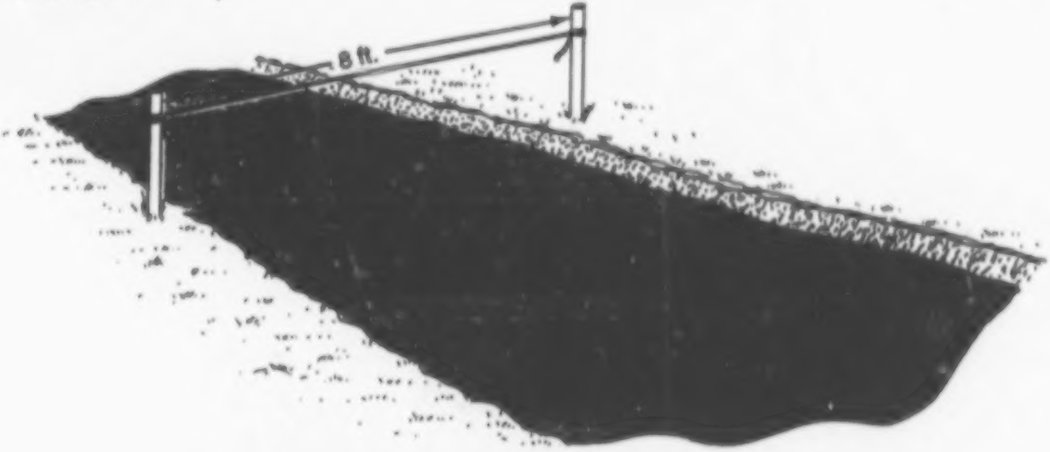
MATERIALS AND EQUIPMENT

- Flowing stream
- Measuring stick
- Measuring tape
- Stop watch
- Float (such as cork, bobber)

PROCEDURE

Functional Reading Skills
- Follow written instructions

	Yes	No
1. Find a straight-flowing area in the stream.	_____	_____
2. Measure the width of the water.	_____	_____



EXAMPLE: 8 feet wide

Math Application Skills
- Select/apply mathematical procedure
- Use English & metric measures
- Solve time/rate/distance problems

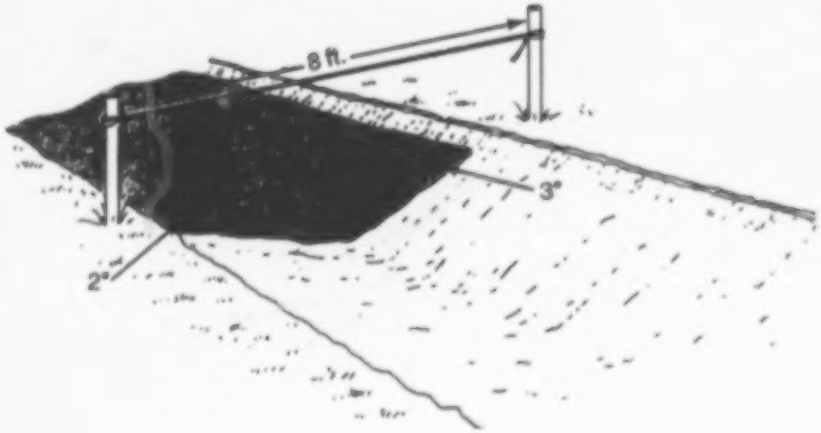
Operation and Calculation Skills
- Calculate with whole numbers
- Calculate with fractions
- Calculate with decimals
- Convert units of measure

Earth Science Skills
- Investigate conservation of physical resources

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

3. Take several depth measurements at the place the width was measured. ____ ____



____ ____

4. Add depth measurements.

EXAMPLE:
2
4
5
8
11
6
3
1
= 40"

5. Divide the total of your depth measurements by the number of measurements taken. ____ ____

EXAMPLE: 40 divided by 8 = 5" average depth.

Yes No

6. Multiply the width of the stream by the average depth and divide total by 12 inches to get the square feet of this section of stream. ____ ____

   EXAMPLE: $\frac{8' \text{ X } 5''}{12''}$ = 3.3 square feet for cross-section

7. Next, check rate of flow in feet per second by measuring a distance on the stream and marking it off with stakes. ____ ____

   EXAMPLE: 60 feet.

8. Drop a float in the water at the upstream stake and time the number of seconds it takes for the float to reach the downstream stake. ____ ____

   EXAMPLE: 60 seconds.

9. Divide the number of feet by the number of seconds to calculate the feet per second. ____ ____

   EXAMPLE: $\frac{60}{60}$ = 1 foot per second

10. To determine the amount of water flowing in the stream, multiply the cross-section of the stream by the average rate of flow. ____ ____

    EXAMPLE: 3.3 square feet x 1 foot per second = 3.3 cubic feet per second.

11. To get the average velocity, use a factor of .8 multiplied by the speed of flow. ____ ____

    EXAMPLE: 3.3 cu. ft. per second x .8 = 2.6 cubic feet per second.

    NOTE: The velocity factor of .8 is used because the water in the center of most streams moves faster than it does along the banks.

	Yes	No
12. To convert cubic feet of flow per second to gallons per minute, first convert the figure to gallons per second.	____	____
NOTE: 1 cubic foot equals 7.48 gallons.		
EXAMPLE: 2.6 cu. ft. per second x 7.48 gallons per cu. ft. = 19.45 gallons per second.		
13. To calculate gallons per minute, multiply gallons per second by 60 seconds (since there are 60 seconds in one minute).	____	____
EXAMPLE: 19.45 x 60 seconds = 1167 gallons per minute.		
14. Have instructor check your work.	____	____
15. Put away materials and equipment.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Took width measurement of stream correctly	4	3	2	1
Took depth measurement correctly	4	3	2	1
Calculated cross section correctly	4	3	2	1
Measured rate of flow correctly	4	3	2	1
Determined feet per second correctly	4	3	2	1
Calculated cubic feet per second correctly	4	3	2	1
Calculated velocity correctly	4	3	2	1
Converted to gallons per minute correctly	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

WRITTEN
TEST

IRRIGATE FRUIT AND NUT CROPS

VII

Name ______________________ Score ____________

OBJECTIVE 1

Match terms associated with irrigating fruit and nut crops to their correct definitions. Write the letter of the correct answer in the blank.

___ 1. Surface flow of water from an area

___ 2. Application of supplemental water

___ 3. Incline of the surface of a soil

___ 4. Underground layer of porous rock, sand, etc. containing water, into which wells can be sunk

___ 5. Pounds per square inch; a unit for measuring pressure

___ 6. Amount of water a soil will hold after drainage

___ 7. H_2O; up to 85 percent of a plant's fresh weight

___ 8. Water loss as a vapor

___ 9. Quality of soil that enables water or air to move through it

a. runoff

b. slope

c. drainage capacity

d. soil permeability

e. water

f. dam

g. aquifer

j. dissipation

i. soil tolerance

j. evaporation

k. field capacity

l. irrigation

m. SPI

n. water table

o. PSI

OBJECTIVE 2

List factors affecting water quality. Write three factors in the blanks provided.

1. ____

____

May be photocopied for student use.

2. ______________________________

____

3. ______________________________

____

OBJECTIVE 3

State advantages and disadvantages of the four methods of irrigation. Write two advantages and two disadvantages for each method in the blanks provided.

Surface – Water conveyed directly over area

Advantages:

1. ______________________________

2. ______________________________

Disadvantages:

1. ______________________________

2. ______________________________

Subsurface – Water released underground to move upward to plant roots

Advantages:

1. ______________________________

2. ______________________________

Disadvantages:

1. ______________________________

2. ______________________________

Aerial (sprinkler) – Water under pressure released into the air

Advantages:

1. ______________________________

2. ______________________________

May be photocopied for student use

Disadvantages:

1. ______________________________

2. ______________________________

Trickle or Drip -- Frequent, slow water application directly to the soil near individual plants through small pipes, tubes, and/or emitters

Advantages:

1. ______________________________

2. ______________________________

Disadvantages:

1. ______________________________

2. ______________________________

OBJECTIVE 4 **Select from a list sources of water supply.** Place an "X" in the blank next to the correct answers.

___ 1. Streams with a steady winter flow

___ 2. Year-round river and streams

___ 3. Drainage ditches

___ 4. Sewer systems

___ 5. Reservoirs, lakes, and ponds

___ 6. Canals and pipelines

___ 7. Fog

___ 8. Wells

May be photocopied for student use.

OBJECTIVE 5

Match methods used to determine when to irrigate crops to their correct descriptions. Write the letter of the correct answer in the blank.

___ 1. Samples are taken from various depths and locations using a tube or auger. The samples are then dried in an oven and weighed to calculate moisture content; method can be time-consuming.

___ 2. An instrument that measures the availability of water held by the soil, no matter what the soil type; placed in the root zone of the plants.

___ 3. Soil samples are taken using a soil tube or auger. Then a handful of the soil is squeezed firmly and compared with the soil moisture and texture guide.

___ 4. An instrument that estimates water loss from the soil by measuring the amount of water that evaporates from the device.

___ 5. In fruit crops, wilted leaves will indicate a need for water. By this time, however, fruit growth may already be retarded, so continuous soil moisture tests are recommended.

a. atomizer

b. soil samples

c. water samples

d. atmometer

e. field test

f. tensiometer

g. "feel" test

h. wilt test

i. observation

OBJECTIVE 6

Complete sentences describing irrigation needs for various fruit and nut crops. Write the correct answers in the blanks.

1. Strawberries – Use __________ or ______________ irrigation at planting (a good rain is best!); then use flood or ___________ irrigation the remainder of the year.

2. Blueberries – _________ irrigation; about _________ a day per plant the first year, increased in following years. Should not exceed _________ gallons per plant a day.

May be photocopied for student use.

3. Blackberries – __________ irrigation; fruit requires about __________ inches of water every two weeks for best fruit size.

4. Grapes – ______________ irrigation lines attached to a low ________________ wire are best. The amount of water needed depends largely on ________________.

5. Peaches and nectarines – __________ or __________ irrigation; trees need about one inch of rain per week during the growing season, and __________ inches of rain per week during July and August.

6. Pears – Trees are fairly _______________, but bigger crops can be obtained through irrigation; _______________ are sometimes used.

7. Apples – Consider irrigation if trees are producing less than __________ to __________ inches annual terminal growth and producing small, poor quality fruit; surface watering through __________ is used in the West.

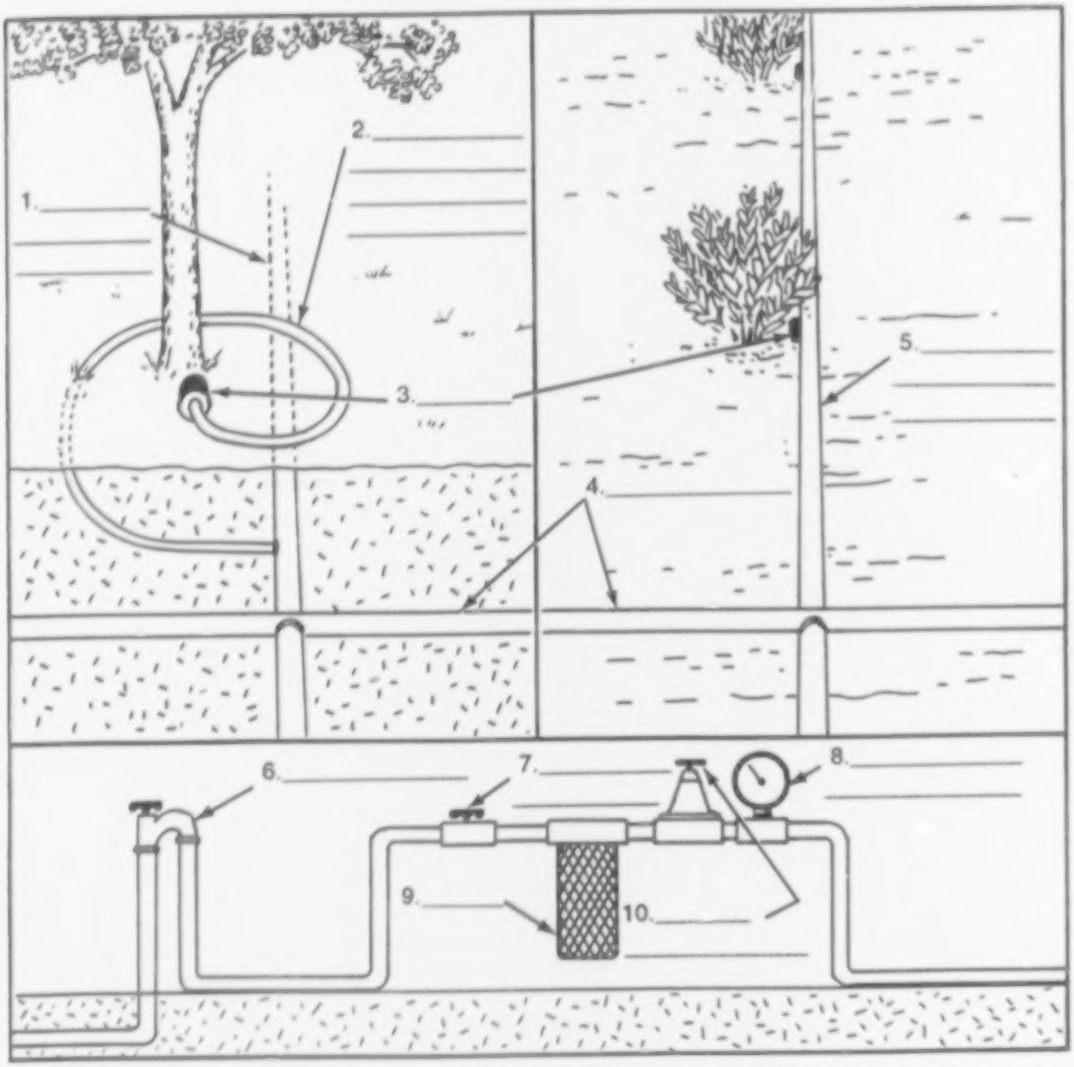
8. Plums – Irrigation is most common in the __________ through furrows, flooding, or __________ irrigation.

9. Cherries – Irrigation rarely practiced in the East since fruits usually mature early in the season before loss of ________________ is a problem.

10. Pecans – __________________ can be a problem in the Southwest on trees irrigated with aerial sprinklers; __________ irrigation is preferred.

May be photocopied for student use.

OBJECTIVE 7 | **Label components of a drip irrigation system.** Write the correct answer in the blanks.



May be photocopied for student use.

OBJECTIVE 8

Match minimum drip irrigation water requirements to various mature, bearing fruit and nut crops. Write the correct letter in the blank. Letters can be used more than once.

	CROP	GALLONS PER DAY
___ 1.	Pecans	a. 1
___ 2.	Peaches	b. 6.5
___ 3.	Apples	c. 13
___ 4.	Pears	d. 8
___ 5.	Sour Cherries	e. 10
___ 6.	Plums	f. 12
___ 7.	Blueberries	g. 15
___ 8.	Grapes	h. 20
___ 9.	Blackberries	i. 25
___10.	Strawberries	j. 30
		k. 40
		l. 5
		m. 9.5

NOTICE: Objective 9 is evaluated on a job sheet in this unit. If you have not completed this component, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

IRRIGATE FRUIT AND NUT CROPS VII

OBJECTIVE 1

1. a
2. l
3. b
4. g
5. o
6. k
7. e
8. j
9. d

OBJECTIVE 2

Answer should include three of the following:

- Presence of suspended particles
- Presence of chemicals
- High soluble salts or high sodium concentrations
- High or low pH

OBJECTIVE 3

Answers should include two advantages and two disadvantages from each of the following categories:

SURFACE

Advantages:

- Small power requirement
- Less water evaporation
- Aids in establishing root-soil contact in new plantings

Disadvantages:

- Very inefficient water use
- Uneven water distribution
- Compacts soil
- High manual labor required for constant monitoring and moving equipment
- May require special land preparation (such as drains and leveling to prevent erosion)

SUBSURFACE

Advantages:

- Minimal evaporative loss from soil
- Promotes deep rooting
- May be used as drain system during excessive rainfall

Disadvantages:

- Land must be level or evenly sloped
- Water movement is uneven
- Visual inspection of distribution system is very limited
- Excessive rainfall can upset application balance
- Salts can accumulate at soil surface

AERIAL (sprinkler)

Advantages:

- Both small and large systems available
- Portable and permanent systems available
- Adaptable to uneven terrain
- Various delivery rates available

Disadvantages

- High evaporative loss
- High cost of equipment
- High power requirement
- Uneven water distribution under windy conditions

TRICKLE or DRIP

Advantages:

- Conserves water because of less evaporation, and water is directed to plants
- Small power requirement
- Aids weed control
- Can be automated
- Can be adapted to variable terrain and plant materials

Disadvantages:

- High maintenance and installation costs
- Requires clean water source or filtering system
- Distribution pipes may be attacked by pest such as rabbits, deer, foxes, and ants

OBJECTIVE 4 2, 5, 6, 8

OBJECTIVE 5

1. b
2. f
3. g
4. d
5. i

OBJECTIVE 6

1. Sprinkle, aerial, drip
2. Drip, 1/2-gallon, five
3. Drip, two
4. Drip, trellis, location
5. Drip, trickle, two
6. Drought tolerant, overhead sprinklers
7. Eight, ten, furrows
8. West, trickle
9. Soil moisture
10. Salt burn, drip

OBJECTIVE 7

1. Below-ground lateral
2. Tree loop
3. Emitter
4. Main line
5. Above-ground lateral
6. Water source
7. Cut-off valve
8. Pressure gauge
9. Filter
10. Pressure regulator

OBJECTIVE 8

1. j
2. g
3. g
4. g
5. g
6. e
7. c
8. l
9. b
10. m

OBJECTIVE SHEET

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

INTRODUCTION

The control of diseases, insects, weeds, and animals in fruit and nut production requires a lot of time, knowledge, and caution. It is important to be able to identify pests so you can treat for them properly, whether it be through spraying or natural methods. Because you may be handling toxic chemicals, you must know the dangers involved with these products and know how to use them safely.

UNIT OBJECTIVE

After completing this unit, the student will know terms associated with controlling insects, weeds, and diseases; know components of integrated pest management; know about toxicity, pesticide labels and storage; and be able to identify some common diseases and insects which may be a threat to fruit and nut crops. In addition, the student will know types of weeds, weedkillers, and equipment used in disease and weed control, as well as various animal controls. The student will demonstrate these competencies by completing job sheets, assignments sheets, and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to :

1. Match terms associated with controlling diseases, insects, and weeds to their correct definitions.
2. Select from a list true statements concerning components of integrated pest management.
3. Select from a list true statements concerning pesticide classifications.
4. Distinguish between acute and chronic toxicity.
5. Define oral, dermal, and inhalation toxicity.
6. Match pesticide information to a sample pesticide label.
7. Select from a list true statements concerning rules for pesticide storage.
8. Complete statements regarding types of diseases that affect fruit and nut production.
9. Match common types of pesticides used in fruit and nut production to their correct descriptions.
10. Match common diseases of pecans to their correct descriptions.

11. Match common diseases of apples and pears to their correct descriptions.

12. Match common diseases of peaches, nectarines, and plums to their correct descriptions.

13. Match common diseases of small fruits to their correct descriptions.

14. Match common insect pests of pecan trees to their correct descriptions.

15. Match common insect pests of fruit and nut trees to their correct descriptions.

16. Match common insect pests of small fruits to the damage they cause.

17. Describe methods of controlling pests.

18. Define annual, biennial, and perennial weeds.

19. List three examples of the various types of grass and broadleaf weeds.

20. Describe methods of controlling weeds without using chemicals.

21. Define the three types of herbicides.

22. Complete statements regarding the correct principles to use in selecting and using herbicides for weed control.

23. Match types of equipment used to apply pesticides to their correct descriptions.

24. Match types of animal controls to the animals.

25. Compute problems involving wet and dry measurements. (Assignment Sheet 1)

26. Calibrate an air sprayer. (Assignment Sheet 2)

27. Calibrate a boom sprayer. (Assignment Sheet 3)

28. Calibrate a hand-held sprayer. (Job Sheet 1)

29. Clean spray equipment after pesticide use. (Job Sheet 2)

30. Collect and submit a plant specimen for disease identification. (Job Sheet 3)

SUGGESTED ACTIVITIES

CONTROL PESTS IN FRUIT AND NUT PRODUCTION VIII

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with controlling diseases, insects, and weeds to their correct definitions.

- Go over terms in information sheet; give examples, when possible, to make terms more understandable.

Objective 2: Select from a list true statements concerning components of integrated pest management.

- Go over the importance of integrated pest management. Ask grower to describe how these components have helped save money and crops.
- Invite a "scout" to talk to the class about what to look for when examining fields, orchards, and crops. Emphasize the importance of catching insects and diseases before they become a large scale problem.

Objective 3: Select from a list true statements concerning pesticide classifications.

Objective 4: Distinguish between acute and chronic toxicity.

Objective 5: Define oral, dermal, and inhalation toxicity.

- Obtain samples (it may be easier and safer to get empty containers with labels intact) of pesticides.
- Inventory the stock of chemicals in your school or worksite and discuss classification, type, how they work, and methods of application.
- Have a physician or poison-control specialist talk to the class about toxicity, first-aid treatment, and consequences of chemical accidents, chemical misuse, or poor handling and storage.
- Refer students to OSU Extension Facts No. 7453, "First Aid for Pesticide Poisoning," and No. 7457, "Toxicity of Pesticides."

Objective 6: Match pesticide information to a sample pesticide label.

Objective 7: Select from a list true statements concerning rules for pesticide storage.

- Invite an extension agent or representative of industry, to discuss label information, MSDS, disposal, and proper storage and handling of chemicals.
- Show videotapes and films on pesticide safety, handling and storing pesticides, reading pesticide labels, hazardous materials disposal, and general safety.
- Have students look over the MSDSs for substances stored in your school or worksite. Discuss the kinds of information contained on the MSDSs.
- Review hazardous warning symbols posted in your area.
- Visit a storage area and discuss what is right/wrong with it.
- Ask students to find a safe place on or near campus for storing chemicals; have them explain the good points or drawbacks to the site.

Objective 8: Complete statements regarding types of diseases that affect fruit and nut production.

- Show students photographs or drawings of various types of diseases that affect fruit and nut crops. You can use pamphlets from the University of Illinois or see if similar color photographs are available from a local university or extension office.

- Have students go through Objectives 10, 11, 12, and 13 to determine whether the diseases were caused by bacteria, virus, fungus, or a physiological problem.

Objective 9: Match common types of pesticides used in fruit and nut production to their correct descriptions.

- Show examples of the various chemical controls – or labels of various brands.

- Provide students with a catalog listing brand names of chemical controls or make your own list from a catalog. Have students classify them according to the categories in the information sheet.

Objective 10: Match common diseases of pecans to their correct descriptions.

Objective 11: Match common diseases of apples and pears to their correct descriptions.

Objective 12: Match common diseases of peaches, nectarines, and plums to their correct descriptions.

Objective 13: Match common diseases of small fruits to their correct descriptions.

- Go over diseases of the various fruit and nut crops. Add any that might be particularly common in your area, if not already listed. An extension agent or local university is a good source.

- Discuss possible ways of combating these diseases. Specific pesticides are not discussed in this unit because the EPA lists of restricted pesticides are continually changing.

- Discuss pesticides and the law. The registration and use of pesticides are determined by the EPA and the state Department of Agriculture. Invite a representative from the EPA or Department of Agriculture to discuss penalties for misuse of pesticides.

Objective 14: Match common insect pests of pecan trees to their correct descriptions.

Objective 15: Match common insect pests of fruit and nut trees to their correct descriptions.

Objective 16: Match common insect pests of small fruits to the damage they cause.

- Provide students with illustrations or photographs of insects discussed in the information sheet. If possible, provide photographs or real-life examples of the damage done by these pests.
- Have a grower discuss ways of controlling pests in fields and orchards. Discuss how "scouts" can assist in identifying pests and diseases.
- Talk about "good bugs," such as Lady Beetles and Praying Mantis. Some companies supply these insects to growers for a price. Obtain copies of their catalogs and distribute them to students.

Objective 17: Describe methods of controlling pests.

Objective 18: Define annual, biennial, and perennial weeds.

Objective 19: List three examples of the various types of grass and broadleaf weeds.

Objective 20: Describe methods of controlling weeds without using chemicals.

Objective 21: Define the three types of herbicides.

Objective 22: Complete statements regarding the correct principles to use in selecting and using herbicides for weed control.

Objective 23: Match types of equipment used to apply pesticides to their correct descriptions.

- Go over the methods of controlling pests and diseases. Show examples or photographs whenever possible.
- Show examples of various types of weeds; let students identify them using various books and reference materials.
- Have students collect weeds from the grounds or a nearby field or orchard. Have students identify the specimens they have collected.

- Go over methods of controlling weeds; discuss biological methods, cultivation, and the use of herbicides.

- Discuss special equipment and protective clothing that may be needed when using herbicides and pesticides.

- Organize a field trip to an equipment sales company that carries equipment used to spread or spray chemicals.

Objective 24: Match types of animal controls to the animals.

- Discuss animal pests in your area; a local grower or extension agent can help with this.

- Discuss the safe use of rodenticides, avicides, etc.

- With a grower's permission, set out a trap in an orchard or field and keep track of your results. Try some of the methods discussed in the information sheet.

Objective 25: Compute problems involving wet and dry measurements. (Assignment Sheet 1)

- Discuss the importance of accuracy in measuring chemical substances. Miscalculations could seriously harms crops — and the environment. Because of the high price of newer pesticides, inaccurate measuring can be very costly.

- Show examples of various measuring containers: cups, quarts, gallons, teaspoons, etc. Be sure they are labeled for pesticide use or kept separate (locked) from kitchen use.

- Explain that an ounce is a unit of weight and that a fluid ounce is a unit of volume.

- Give students practice problems to help them brush up on their math skills. Review multiplication, division, addition, and subtraction.

- Have students complete Assignment Sheet 1.

APPLICATION

Objective 26: Calibrate an air sprayer. (Assignment Sheet 2)

Objective 27: Calibrate a boom sprayer. (Assignment Sheet 3)

Objective 28: Calibrate a hand-held sprayer. (Job Sheet 1)

Objective 29: Clean spray equipment after pesticide use. (Job Sheet 2)

Objective 30: Collect and submit a plant specimen for disease identification. (Job Sheet 3)

- Discuss the various methods of calibrating sprayers, such as acre-volume, area-volume, and time-volume.
- Discuss equipment used in calibration, including some of the newer equipment that will do a lot of the calculating, such as converting distances to miles per hour and gallons per minute, for you. A local extension agent can help.
- Practice calibrating equipment. Invite a local grower to show students how this is done on a large-scale basis.
- Have students complete Assignment Sheets 2 and 3.
- Use Job Sheets to stress the importance of cleaning equipment safely; let students practice cleaning equipment.

  NOTE: For safety reasons, you may want students to use only water and not chemicals when practicing and when performing the tasks.
- Have students complete Job Sheets 1 and 2.
- Set up a display of different diseased plants and identify diseases present.
- Have student complete Job Sheet 3.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.

- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

- *Apple Diseases I and II*, July 1982; *Peach Diseases I and II*, September 1983; *Cherry and Plum Diseases I and II*, October 1983; *Grape Diseases I*, October 1983; *Bramble Fruit Diseases I*, September 1983; *Blueberry Diseases I*, August 1984; *Strawberry Diseases I and II*, August 1984. University of Illinois College of Agriculture Cooperative Extension Service and Vocational Agricultural Service, Urbana, IL.
- *Applying Pesticides Correctly.* Developed by North Carolina State University, in cooperation with the Extension Service, U.S. Department of Agriculture. n.d.
- Brindley, Bill. *The Home Orchard Pest Management Guide.* Utah State University Cooperative Extension service: Logan, UT, May, 1991.
- Campbell, Jesse and Jim T. Criswell. *Toxicity of Pesticides*, No. 7457. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Childers, Norman F. *Modern Fruit Science.* Horticulture Publications: Gainesville, FL, 1983.
- Criswell, Jim. *Check Your Pesticide Labels*, No. 7454. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- Criswell, Jim. *First Aid for Pesticide Poisoning*, No. 7453. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- Criswell, Jim T. *Agricultural Pesticide Storage*, No. 7451. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- De Saulles, Denys. *Home Grown.* Marshall Editions Ltd.: London, England, 1988. (First published in the USA by Houghton Mifflin Co., Boston, MA. 1988.)

- Dewey, Steven A., Alvin R. Hamson, and William A. Varga, *Weed Control for the Homeowner.* Cooperative Extension Service, Utah State University: Logan, UT, n.d.

- *Growing Small Fruits in the Home Garden.* Circular 935. University of Illinois at Urbana Champaign, College of Agriculture, Cooperative Extension Service. 1984.

- *Growing Tree Fruits in the Home Orchard.* Circular 1013. University of Illinois at Urbana Champaign, College of Agriculture, Cooperative Extension Service. 1987.

- *Introduction to Horticulture*, Chemical Safety Unit. Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center: Stillwater, OK, 1990.

- *Master Gardener.* Utah State University Cooperative Extension: Logan, UT, n.d.

- McDonald, Sally A. *Applying Pesticides Correctly. A Guide for Private and Commercial Applicators.* Developed by North Carolina State University in cooperation with the Extension Service, U.S. Department of Agriculture, n.d.

- McEachern, George Ray. *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Co.: Houston, TX, 1978.

- *Oklahoma State University Extension Agents' Handbook of Insect, Plant Disease and Weed Control.* Cooperative Extension Service, Division of Agriculture Sciences and Natural Resources, Oklahoma State University: Stillwater, OK, 1992.

  NOTE: This handbook is revised and published annually. Copies may be ordered (for $10) from Central Mailing Services, Publishing and Printing East, OSU, Stillwater, OK, 74078.

- Payne, Jerry A., Howard L. Malstrom, and Glenn E. Kenknight. *Insect Pests and Diseases of the Pecan.* Agricultural Research (Southern Region), Science and Education Administration, U. S. Department of Agriculture: New Orleans, LA, 1979. (Available from the Southeastern Fruit and Tree Nut Research Laboratory, P. O. Box 87, Byron, GA 31008.)

- *Pecan Production in the Southeast, A Guide for Growers.* (Circular ANR-459). Alabama Cooperative Extension Service: Auburn University, AL, 1989.

- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.

- Sholar, Ron. *Integrated Pest Management for Oklahoma Crops*, No. 7458. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

- *Utah Fruit and Pest Control.* (EC299). Cooperative Extension Service, Utah State University: Logan, UT, n.d.

OBJECTIVE 1

Match terms associated with controlling diseases, insects and weeds to their correct definitions.

- **blight** — the rapid discoloration and death of tissues on certain areas of plants; may be caused by an air or soil condition, or by an insect

  EXAMPLES: Twig blight, tip blight, cane blight

- **calibration** — measuring and adjusting the amount of pesticide a piece of equipment will apply to a specific area
- **canker** — a dead area on a stem surrounded by living tissue
- **chlorophyll** — green substance found in plants; involved in photosynthesis
- **combustible** — capable of bursting into flames
- **defoliate** — stripping of leaves
- **exudate** — a substance that oozes or discharges from the plant
- **Integrated pest management (IPM)** — the practice of holding pest numbers or their damage below the point where their presence would cause economic loss

  NOTE: IPM also involves integration of insect and disease control with other management practices.

- **mildew** — powdery or cobweb-like growth of fungus, usually found on leaves
- **nonselective** — kills all it comes in contact with
- **postemergence herbicides** — applied to small emerging weeds that are actively growing
- **preemergence herbicides** — applied before weed seeds germinate and kill the weeds as they germinate
- **selective** — affecting specific plants or specific parts of plants
- **systemic** — inside and moving throughout the plant

- **toxic** – poisonous

- **toxicity** – the ability of a poison to produce adverse effects

  NOTE: Toxicity symptoms can range from a slight headache or lightheadedness to convulsions, coma, and death.

- **translocated** – food materials, pesticide, or herbicide moved from one part of the plant to another

  EXAMPLE: A translocated herbicide can be applied to the leaves and will travel through the plant to the roots and kill them.

- **weed** – any plant growing where it is unwanted

OBJECTIVE 2 **Select from a list true statements concerning components of integrated pest management.**

- **Field scout or checking** – Field scouts check fields on a regular basis and determine the kinds and numbers of insects, diseases, animals, and beneficial organisms present.

  NOTE: Scouting can also be used in weed control. By identifying types of weeds, their stages of growth, growers can determine what herbicides to use on them.

- **Improved pest control** – IPM relies on several control alternatives such as chemicals, cultural practices, plant resistance, and natural controls to provide effective pest control.

- **Economic crop protection** – IPM reduces costs by treating pests when there is a NEED, as opposed to relying on a calendar schedule. When pesticides are required, timely and efficient applications also reduce costs.

- **Protection of the environment** – IPM works to safeguard human health while preserving the delicate natural balance within the environment.

OBJECTIVE 3 **Select from a list true statements concerning pesticide classifications.**

Class I Pesticides

- Highly toxic

- Identification symbol: "DANGER" or "POISON" with a skull and crossbones

- Poses a threat to humans, animals, or the environment, even when used as directed

- Classified as "Restricted Use"

  NOTE: "Restricted Use" means that for private and non-commercial use, the applicator (person using the chemical) must be trained and pass certification tests in the appropriate category to use Class I pesticides. Commercial applicators are required to be certified regardless of the classification of pesticide use.

Class II Pesticides

- Moderately toxic

- Identification symbol: "WARNING"

- Poses a threat to humans, animals, or the environment, even when used as directed

- May be classified as "Restricted Use"

Class III Pesticides

- Slightly toxic

- Identification symbol: "CAUTION"

- Not likely to harm humans, animals, or the environment when used as directed

  NOTE: Some Class III pesticides, such as Dimilin, are restricted-use pesticides because of their effect on the environment.

Class IV Pesticides

- Relatively non-toxic

- Identification symbol: "CAUTION"

OBJECTIVE 4 **Distinguish between acute and chronic toxicity.**

- Acute toxicity refers to how poisonous a chemical is after one exposure. Acute poisoning can occur after a single small or large exposure. Symptoms develop quickly, within a few minutes or within a few hours.

- Chronic or cumulative toxicity refers to how poisonous a chemical is after repeated small doses. Chronic poisoning occurs over a period of time. In some instances, symptoms appear as quickly as in one week. However, toxic buildup can take many years before symptoms appear. People who load chemical products, work in the same building with toxic materials, mix chemicals, or work in chemically treated fields can develop chronic toxicity.

OBJECTIVE 5

Define oral, dermal and inhalation toxicity.

- **Oral toxicity** – Poisoning in or through the mouth

  NOTE: Oral toxicity is often associated with eating or drinking a poison. You wouldn't eat or drink pesticides or herbicides, but these chemicals on your hands can get into your system through your mouth. That's why the safety precautions say "Don't eat, drink, or smoke while handling chemicals."

- **Dermal toxicity** – Poisoning on or through the skin

  NOTE: Pesticides and other poisons can be absorbed into your body through your skin whenever the chemical comes in contact with your body. When you get chemicals on your clothes, they hold the chemical next to your skin. You are at risk for dermal poisoning whenever chemicals splash or drip onto your skin.

- **Inhalation toxicity** – Poisoning by breathing in fumes or particles

  NOTE: Inhalation toxicity is especially dangerous because the toxin goes to your lungs, is carried directly into your bloodstream and then to your brain. You may not be able to smell fumes or vapors and may not know you are inhaling them until you get dizzy, vomit, or pass out.

OBJECTIVE 6

Match pesticide information to a sample pesticide label.

The sample label on page 16 shows the various information that should be included on pesticide labels.

- Use classification (10

  EXAMPLE: Restricted use

- Trade or brand name (2)
- Ingredient statement (3)

- Common and chemical names (4)

  EXAMPLES: Dodeporph acetate, malathion, diazanon

  NOTE: The chemical name indicates the chemical composition of the active ingredient.

- Signal words and symbols (5)

  NOTE: Signal words tell approximately how toxic the pesticide is to people. The signal words are set by law.

  EXAMPLES: DANGER, WARNING, CAUTION, POISON

- Statement of practical treatment (6)

  NOTE: Label includes antidote information for physician or poison control center. Highly toxic chemicals are required to have a statement of practical treatment. Less toxic pesticides will also provide first-aid instructions.

- Name and address of manufacturer (7)
- Registration and establishment numbers (8)
- Precautionary statement (9)

  NOTE: These statements alert applicators to hazards to the applier, children, animals, and the environment.

- Hazards to humans and domestic animals (10)
- Environmental hazards (11)
- Physical or chemical hazards (12)
- Directions for use (13)
- Re-entry statement (14)
- Category of applicator (15)

  NOTE: Some pesticides may only be used in certain categories of commercial applicators.

- Storage and disposal directions (16)
- Net contents (17)

EXAMPLE LABEL:

PRECAUTIONARY STATEMENTS
⑨

DANGER

⑩ HAZARDS TO HUMANS (& DOMESTIC ANIMALS)

Poisonous by swallowing or inhalation. Do not breathe spray mist. Do not get in eyes. Avoid contact with skin. Wear a mask or respirator of a type passed by the U.S. Bureau of Mines for De Pesto protection. For emergency assistance call 000-000-0000.

TO PHYSICIAN; Do not use oximes such as 2-PAM. Give Atropine 2mg. intravenously or subcutaneously. If in eye instill one drop of Homatrophine.

ENVIRONMENTAL HAZARDS ⑪

This product is toxic to fish, birds and other wildlife. Birds feeding on treated areas may be killed. Keep out of any body of water. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes. This product is toxic to bees and should not be applied when bees are actively visiting the area.

⑫ PHYSICAL OR CHEMICAL HAZARDS

WARNING – Flammable! Keep away from heat or open flame

⑬ DIRECTIONS FOR RESTRICTED USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

RE-ENTRY STATEMENT ⑭

Do not enter area within five days after application.

CATEGORY OF APPLICATOR ⑮

For use only by agricultural pest control applicators.

⑯ STORAGE AND DISPOSAL DIRECTIONS

STORAGE – Store in original container. Do not store next to food or other articles intended for consumption by humans or animals.

DISPOSAL – Do not reuse container. Destroy by burying in a safe place.

OR

Contact State or Regional Federal Authorities for local restrictions on disposal.

①

RESTRICTED USE PESTICIDE

FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.

② PEST-A-WAY

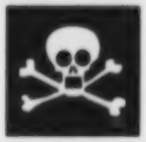
③ ACTIVE INGREDIENT:	*Pestzapper ④	40.50%
INERT INGREDIENTS:		59.50%
TOTAL:		100.00%

*Betabugazene ④

This product contains 0.5 lbs of Pestzapper per gallon.
Pestzapper is a registered trademark of Weedy Corporation.

KEEP OUT OF REACH OF CHILDREN

⑤ DANGER — POISON



⑥ STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED – Induce vomiting by giving a tablespoon of salt in a glass of warm water. Repeat until vomitus is clear. Call a physician immediately.

IF INHALED – Remove to fresh air. Call physician immediately.

IF IN EYEs – Flush eyes with plenty of water for at least 15 minutes. Call a physician immediately.

IF ON SKIN – In case of contact, remove contaminated clothing and immediately wash skin with soap and water.

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

⑦ MFG BY WEEDY CHEMICALS
TOWN, STATE, USA

⑧ ESTABLISHMENT NO. 0816-YZ-4
EPA REGISTRATION NO. 1033-34

⑬ DIRECTIONS FOR RESTRICTED USE CONTINUED

BLUEBERRIES: For use in controlling the 3-horned berry slurper. Refer to chart and apply recommended amount when pests appear. Observe indicated number of days before harvesting. Do not apply more than once per season.

MINIMUM GALLONAGE REQUIREMENT: Three gallons of mixed spray per acre with ground equipment, one gallon per acre with aircraft.

⑰ NET CONTENTS ONE GALLON

OBJECTIVE 7

Select from a list true statements concerning rules for pesticide storage.

- Storage area should be down-wind and downhill from sensitive areas such as houses, play areas, feed lots, animal shelters, gardens, and ponds.
- Area should be securely locked and identified with warning signs.
- Area should be well-ventilated.
- Area should be childproof.
- Area should be proper temperature (check labels for storage temperatures).
- Herbicides, insecticides, fungicides, etc. should be stored, in separate locations within the storage area.
- Chemicals should be stored in original containers.

  NOTE: If containers break or leak, change to a sturdy, sealable container and label immediately.
- Location of hazardous chemicals must be on file with the fire department.
- Leaking containers and old chemicals should be disposed of.

  NOTE: Follow specific label instructions.
- Don't accept chemicals without their MSDSs.

  NOTE: MSDS stands for Material Safety Data Sheet. It must be requested from the manufacturer. The MSDS lists hazards, chemical composition, antidotes, chemical stability, and other factors. The amount of information provided can vary from a single page to 10 or more pages, depending on the manufacturer.

OBJECTIVE 8

Complete statements regarding types of diseases that affect fruit and nut production.

- **Fungus** — lower plant forms that lack chlorophyll, true roots, stems, and leaves; parasites which live on organisms or feed on dead organic material; fungus diseases reproduce by microscopic spores that are carried through the air, rain, or by insects; often microscopic, but can be seen when present in large quantities; can usually be controlled through fungicide spraying programs

NOTE: Fungus includes molds, mildews, rusts, smuts, mushrooms, toadstools, and yeast. Some soil fungi are essential for healthy soil. Fungus on roots, stems, leaves, or flowers can cause plant disease.

EXAMPLES: Scab lesions on apple leaves and fruit; brown rot on peaches, plums, and cherries

- **Bacterial** — one-celled microorganisms that have no chlorophyll; difficult to control by spraying; usual control method is to burn plants or remove infected areas and disinfect the pruning wounds

EXAMPLES: Fire blight of apple, pear; crown gall

- **Viral** — ultra microscopic organisms that cause various diseases in plants; cannot be controlled directly by spraying; are best battled by cross-breeding to develop resistant varieties of plants and controlling insects that transmit viruses

EXAMPLES: Leaf pucker and russet ring on apples; streak disease of brambles; yellows disease of strawberries

- **Physiological** — diseases attributed to natural problems such as poor nutrition, adverse weather, poor grafting, etc.

EXAMPLES: Scald, bitter pit of apples; "little leaf" of many fruit trees caused by zinc deficiency

OBJECTIVE 9

Match common types of pesticides used in fruit and nut production to their correct descriptions.

- **acaricide** — kills or repels spiders, mites, and ticks
- **avicide** — kills or repels birds that harm or destroy crops
- **bactericide** — kills bacteria
- **fungicide** — prevents fungi
- **herbicide** — selective or nonselective material for killing weeds or preventing weed seed germination
- **insecticide** — kills insects
- **miticide** — kills mites

NOTE: Mites are tiny spiders that feed on the underside of leaves. They are also called red spider mites.

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- **nematicide** — kills nematodes

  NOTE: Nematodes, or eel worms, are insects 1/125 of an inch long that attack plant roots. They feed on the root and lay their eggs in it, causing knots to form. The plant loses nourishment from the roots and dies.

- **nonselective pesticide** — kills all pests

  NOTE: Fumigants are about the only thing that will kill **all** pests.

- **pyrethrum** — insecticide made from dried, powdered chrysanthemum flowers

  NOTE: The organic (natural) forms found in pesticides are called pyrethrins; the synthetic (manufactured) forms are called pyrethroids.

- **rodenticide** — kills small rodents that feed on crops or seeds

  EXAMPLES: Mice, gophers, moles

- **selective pesticide** — kills some pests while not affecting others

  NOTE: Certain chemicals are harmful to certain plants. Dangers are listed on the label.

OBJECTIVE 10

Match common diseases of pecans to their correct descriptions.

- **crown gall** — large galls on roots and bases of trunk
- **bunch disease (also called witches' broom)** — bushy growths of slender, willowy shoots; forces growth into the lateral buds
- **powdery mildew** — powdery white growth on nuts, foliage; may cause nuts to stay small, shucks to split early, and kernels to shrivel
- **rosette** — leaves turn yellow, become twisted, and later reddish-brown; causes twigs and limbs and, eventually, tree to die; caused by zinc deficiency, usually from alkaline or low-zinc soils

  NOTE: The above is a nutritional deficiency.

- **scab** — small, dark, circular, olive to black spots on foliage and nuts; if not controlled, crops and some trees could be lost when there are frequent rains or extended dew.

  NOTE: This is the time when spores germinate on leaflets, twigs, and nut shucks.).

OBJECTIVE 11 **Match common diseases of apples and pears to their correct descriptions.**

- **bitter rot** — small, light brown spots on fruit which enlarge and darken, turning almost black; saucer-shaped depression forms in center
- **bitter pit** — spots form under skins of fruit and later turn brown and rot in storage; caused by lack of or reduced calcium and fluctuating amounts of water in growing season
- **black rot** — small purple specks on leaves which grow to dark spots with yellowish centers (frogeyes); may cause fruit to shrivel into black "mummies" that hang on tree throughout winter

  NOTE: Black rot is also called frogeye leaf spot.

- **cedar apple rust** — occurs on leaves, fruit, and sometimes twigs; starts as pale, yellow spots on leaf surface that grow and turn orange; on underleaf, orange-yellow, tube-like structures called aecia form in each spot; on fruit, lesions appear near the calyx end and are larger than leaf lesions

  NOTE: This disease is very common

- **collar rot** — caused by soil-borne fungus; blackened, cankered area develops on ground area of main trunk; gummy exudate is found under dead bark; bark on infected area dries and canker becomes more visible; often causes tree to die
- **fire blight** — blossoms appear water-soaked and wilt, turning brown; shoots wilt from the tip and turn dark, as if scorched by fire; the end of the shoot bends into a crook shape; bacteria can kill a young tree
- **flyspeck** — consists of shiny, black dots in clusters of 10 to 50 and look like flyspecks; usually occur together with sooty blotch
- **powdery mildew** — attacks one-year-old shoots, including foliage, blossoms, and fruit; small, white spots appear on underside of leaves, enlarging to cover the surface; black spots develop in the white area; blossoms infected by the fungus will not produce fruit, and already formed fruit will be malformed

- **scab** – on leaves, appears as green to brown spots that darken with age; causes leaves to drop early; on fruit, infection becomes brownish-black and corky; fruit may look scabby, knotty, or misshapen.

- **sooty blotch** – appears as a smudge; usually occurs with flyspeck

OBJECTIVE 12

Match common diseases of peaches, nectarines, and plums to their correct descriptions.

- **bacterial spot** – round, small red spots on leaves that turn brown in the center and drop out, leaving holes; on twigs, dark blisters turn into cankers; on fruit, spots turn into dark saucer-shaped depressions with gummy, yellow exudate

- **brown rot** – small brown spots appear on fruit as it nears maturity; moisture makes spots enlarge and grayish-white tufts appear on skin

- **peach leaf curl** – puckered, curled, distorted leaves; thicker than other leaves; infected leaves turn yellow or brown and drop; infected fruits get irregular, bumpy areas; fruit usually drops prematurely

- **peach scab** – small, round, blackish spots on fruit about six weeks after petal fall; cracking may occur; twigs get yellow-brown blotches, outlined in gray or blue; leaf spots are brown; holes appear as leaves dry out

- **plum pocket (similar to peach leaf curl)** – small, white spots on fruit; spots grow quickly and may cover entire fruit; flesh turns spongy and seed stops developing, turns brown and withers. Fruit becomes larger than normal and inside dries up, leaving only a shell

- **powdery mildew** – patches of white, or sometimes grayish or brown fungus; immature fruits are highly susceptible and have brown blotches that are scabby and malformed

OBJECTIVE 13

Match common diseases of small fruits to their correct descriptions.

GRAPES

- **botrytis** – fuzzy, gray growth on fruit and leaves; usually occurs in cool, wet conditions

- **black rot** – reddish-brown spots on upper leaf; these enlarge and merge to create blotches with tannish-brown centers and a darker outline; on fruit, rot starts as pale spot that turns brown; entire berry becomes covered and shrivels to a black "mummy"

- **downy mildew** – pale, yellow spots on upper leaf, white coating appears on underside; spots turn brown with age; young fruits stop growing and turn dark and dry

- **grape anthracnose (black spot)** – fruit, young shoots, tendrils, petioles and leaf veins get small sunken spots with dark borders; leaves may appear ragged and distorted

- **powdery mildew** – white, powdery patches on leaves, young canes, and grapes

BLACKBERRIES

- **anthracnose** – small, ashy spots on canes, especially near bottom; spots on leaves and fruits and fruit "mummies"

- **botrytis** – fruits decay and shrivel into "mummies"; when damp, fruits and blossoms covered with gray mold

- **crown gall** – round swelling on roots and sometimes galls on canes; young galls usually soft and white

- **powdery mildew** – white, powdery substance on stems, leaves, and/or berries; plants in dry soil most likely to suffer from it

- **orange rust** – spindly young shoots; pale green to yellowish leaves; in spring, underside of leaves covered with orange powdery spores

- **rosette (double blossom)** – several leafy shoots develop from infected buds; shoots are smaller than normal and have pale green foliage that turns bronze; petals on infected flower buds are pinkish, wrinkled, and twisted, giving a "double" appearance

STRAWBERRIES

- **gray mold (botrytis rot)** – kills blossoms and rots fruit; fruit is discolored, turns brown as it starts to ripen; often occurs after dense growth of foliage and rainy weather during ripening

- **red stele (red stripes inside roots) and verticillium wilt** – stunting, yellowing, gradual withering and dying of plants; caused by soil-borne fungi that infect the roots and kill the plant

- **leaf spot** – circular spots, up to 1/4 inch on upper leaf; spots are purplish-red turning to gray to white centers with purplish borders; can attack all above-ground parts of plant; usually infected during cool, wet weather when leaves are young; caused by fungus

- **leaf scorch** – spots up to 1/4 inch in diameter, dark purple, later growing and turning dark brown, giving "scorched" appearance; can attack caps, leaves, and stems and prevent fruit from forming properly

BLUEBERRIES

- **anthracnose, stem canker and stem blight** – gray or brown cankers appear; stems die back and cause leaves to brown and wither

- **crown gall** – round swelling on roots and sometimes galls on canes; young galls usually soft and white

- **powdery mildew** – white, powdery substance on stems, leaves, and/or berries; plants in dry soil most likely to suffer from it

OBJECTIVE 14

Match common insect pests of pecan trees to their correct descriptions.

- **aphids** – infestations may cause defoliation and reduce the nut crop; the black pecan aphid causes bright-yellow rectangular areas on leaves, which eventually turn brown and the leaf drops

- **fall webworm** – caterpillars which produce large, dirty-white webs on trees in late summer and fall; control is needed only when pests are numerous in a grove, but webs should be knocked down when caterpillars are small

- **hickory shuckworm** – whitish caterpillars up to 1/2 inch long that feed on the interior of immature nuts; later in the season, they tunnel into the shucks; powdery white stain around entry point on nut may be visible

- **pecan nut casebearer** – insects that pass the winter in cocoons found where the bud joins the stem; become active in the spring, feeding on buds and then boring into young shoots; newly hatched insects do the most damage, attacking newly-set nuts; infested nuts are recognized by silken threads that hold them together

- **pecan weevil** – light-brown or grayish beetle about 1/2 inch long with a long beak; it attacks the nut; adults feed on kernels before the shell is hard; larvae feed on partially matured nuts; holes in the shells may be noticed

- **phylloxera** – small sucking insects that cause tumor-like swellings or galls to appear on leaves, leafstalks, succulent shoots, and nuts of new growth. There are several species, but *phylloxera devastratrix* is most damaging, causing malformed, weak shoots that eventually die.

- **twig girdler** – grayish-brown beetles, 1/2 inch to 5/8 inches long, with reddish heads and long antennae; adult insect often girdles the twigs in late summer and in fall, causing injured branches to break off or hang loosely from trees

- **walnut caterpillar** – feeds in groups, often eating all the leaves on small trees or individual limbs of large trees; full-grown caterpillars are black, two inches long and covered with dirty-white or gray hairs

- **San Jose scale** – look for crusted scales on branches; they feed on plant sap under the visible shield; infested leaves often drop branches, get weak, and die

OBJECTIVE 15 **Match common insect pests of fruit and nut trees to their correct descriptions.**

There are three types of insects that attack fruit and nut crops: chewing insects, which have hard mouth parts they use to bite off parts of the plant; sucking insects, which have tubelike mouth parts that they insert through the skin and tissues of the leaves fruits and stems; and lapping insects, which have lapping mouth parts.

- **aphid** – small insects that feed on sap, cause stunted growth; usually found in clusters on buds, leaves, and tips of shoots of fruit trees

- **borers** – attack trunk and branches of stone fruits, particularly peaches; adults emerge mid-May to September and lay eggs on bark; larvae then hatch and must get under loose bark for protection; eventually girdle and kill tree

- **cat-facing insects** – also called plant bugs; feed on young fruit and can affect fruit development and leave deep, unsightly depressions in fruit; problem is particularly prevalent in stone fruits

  EXAMPLES: Stink bugs, box elder bugs

- **coddling moth** – attacks apples; lives during the winter behind loose bark on the tree; moths lay their eggs on leaves and fruit; the larvae damage apples by chewing their way into the core of apples; the tunnel opens the way for diseases
- **leafhoppers** – small, brightly colored insects that chew leaves and produce tiny white spots and sickly appearing plants
- **oriental fruit moth** – in the spring, larvae bore into young shoots, causing them to die; later in the season, larvae feed on fleshy part of fruit and exit through holes in sides; there may be a gummy exudate at exit hole; when full grown, they are 1/2 inch, and a pink color; peaches are most severely damaged
- **plum curculio** – attacks orchard fruits, including apple, peach, plum, pear, and cherry; insect is a dark-brown beetle that feeds on newly forming fruits; eggs are laid in the skin; larvae tunnels through fruit causing it to drop or rot
- **red mites and two-spotted mite** – attack apples, other orchard fruit, and strawberries; mites are extremely small, and are best seen with a magnifying glass; often found on the underside of leaves; they suck juices from the leaves causing the foliage to turn yellow and then brown
- **San Jose scale** – attacks all kinds of fruit trees; feeds on branches, leaves and fruits, causing red, spotted areas; infested leaves often drop; branches get weak and die
- **tent caterpillar** – casement of webbing can hold hundreds of larvae near branch tips; tips will be defoliated; caterpillars are black, 1/2 inch to 1 1/4 inch and are "leaf chewers;" adults are moths about 1/2 inch long with light yellow or red/brown wings about 1 to 1 1/3 inches long

OBJECTIVE 16 **Match common insect pests of small fruits to the damage they cause.**

GRAPES

- **aphids** – cause pale, green leaves with curled tips
- **leaf folders** – fold leaves and the caterpillars eat inside
- **mealy bugs** – white or gray, cottony fluff on stems
- **red spider mite** – grayish, speckled, or yellow leaves

  NOTE: These tiny red insects can be seen with hand lens.

- **scale insects** – sticky, dark bark; small, dark raised spots on underside of leaves; sometimes black patches on leaves

BLACKBERRIES

- **aphids** – suck sap from leaves causing them to become curled and stunted; weaken plant and may transmit viral disease

- **cane borer** – weak growth, hollow stems on old canes and holes where insects have left

- **Japanese beetles, other beetles, caterpillars** – chews leaves

STRAWBERRIES

- **aphids** – feed on leaves, causing them to become curled and twisted

- **crown borer** – feeds inside the plant near the soil, weakening or killing the plant. White grubs (large grubs) kill the plant by feeding on the roots

  NOTE: Crown borers are thick, white grubs about 1/5 inch long.

- **strawberry beetle** – feeds on flesh of fruit leaving holes; sometimes removes seeds

  NOTE: Strawberry beetles are black and about 1/2 to 3/4 inches long.

- **strawberry weevil or clipper** – cuts off buds, leaves, and fruit; leaves them hanging as if they had been partly broken off

OBJECTIVE 17 **Describe methods of controlling pests.**

- **Spraying** involves the application of chemicals in liquid form to fruit plants to prevent or combat attacks by insects and diseases.

- **Dusting** is the application of chemicals in dust form to plants to prevent or combat attacks by insects and diseases.

  NOTE: Dusting is rarely, if ever used now.

- **Natural controls** can be used to control some pests. Some insects and diseases can be controlled by natural means, without human assistance. Examples are temperatures, moisture, or light that is unfavorable to certain pests and diseases, or species that are resistant to these problems. In addition, certain insects can be introduced into an orchard or field to control destructive fungi, bacteria, or other pests.
- **Destroying or burning** – Orchard pests often live through the winter in plant debris such as leaves, old fruit, and pruned branches. Clearing and burning this debris will help control insects, diseases, and other pests such as mice and rabbits.
- **Mechanical guards** such as fences and wire guards around the base of trees and plants can help prevent injury from mice, rabbits and other animals.
- **Sanitation** can reduce the incidence of certain pests. Packing and storage areas need to be kept clean. This will keep insects such as codling moths, that have overwintered in old boxes and crates, from returning in the spring.
- **Crop rotation** helps control the buildup of pests that are known to attack a certain crop.
- **The use of sterilized insects** can help reduce insect pests. Releasing sterilized male insects of certain species can reduce the population of those problem insects.
- **Nursery inspection** can keep diseased or insect-infested plants from reaching the fields. Infested or diseased stock should be destroyed.
- **Selection of resistant varieties** helps control pest damage.

OBJECTIVE 18 **Define annual, biennial, and perennial weeds.**

- **annual** – completes its life cycle in one season
- **biennial** – can store food for a second year of growth
- **perennial** – live for more than two seasons

OBJECTIVE 19 **List three examples of the various types of grass and broadleaf weeds.**

- **annual grasses** – goosegrass, crabgrass, witchgrass
- **perennial grasses** – nutsedge, bermudagrass, johnsongrass, quackgrass

- **annual broadleaf** — carpetweed, redroot pigweed, cocklebur, chickweed, wild mustard, henbit, jimsonweed
- **perennial broadleaf** — dandelion, morning glory, dock, horse nettle
- **woody perennial broadleaf** — poison ivy, trumpetcreeper, japanese honeysuckle, wild blackberries

OBJECTIVE 20

Describe methods of controlling weeds without using chemicals.

- **The use of insects and disease-causing agents** attack the unwanted species of weeds.
- **Grazing** by sheep, goats, or geese is usually used to control weeds along ditches, roadsides, and fences.
- **Tillage** is often used to kill or control weeds in row crops. However, tillage may bring buried seeds to the surface where they can germinate and compete with crops.
- **Reduced tillage** reduces weed growth without turning up as many weed seeds or causing as much erosion.
- **Mowing** may be used to reduce weeds and to prevent annual or biennial weeds from flowing and seeding. It is often used in orchards to control weeds and prevent soil erosion.
- **Burning** may help control annual and biennial weeds. However, it destroys only the above-ground parts of plants and is not effective against many herbaceous perennial weeds.
- **Mulching** is used to prevent light from reaching the weed seeds, thus preventing the weeds from growing.

  EXAMPLE: Black plastic around strawberry plants.
- **Time of planting** can help control weeds. Crops planted in the spring compete well against winter annual weeds. Sometimes a planting date can be delayed until after weeds have sprouted and have been removed by cultivation and/or herbicides.
- **Cover crops** eliminate the "bad" weeds by planting other grass or vegetation that will compete with them.

OBJECTIVE 21

Define the three types of herbicides.

- **contact herbicides** – kill foliage, but have little or no effect on plant roots; annuals can usually be killed with one application but it may take several applications for perennials
- **translocated herbicides** – kills all parts of the plant from the leaves to roots

  NOTE: These must be applied to actively growing weeds.
- **preemergence herbicides** – applied to the soil and kill germinating seedlings

OBJECTIVE 22

Complete statements regarding the correct principles to use in selecting and using herbicides for weed control.

- Know the weed species before choosing a herbicide.
- Read the label for registration approval, precautions for applying the herbicide, stage of crop development for chemical application, limitations, and directions for use.
- Newly registered herbicides or a herbicide new to the user should be tried on a small area the first time to allow the grower a chance to see the effects of the chemical.
- Apply at the suggested rate for your soil type and for the stage of crop or weed development. Apply the herbicide evenly, accurately, and at a uniform rate.
- Know the best application time for each herbicide, depending on whether it is preemergence or postemergence.
- Know factors that affect herbicide performance.

OBJECTIVE 23

Match types of equipment used to apply pesticides to their correct descriptions.

MANUAL

NOTE: These are most common for home use.

- **compressed air sprayers (canister or backpack)** – Can be used on most crops except large trees such as pecans, apples, and pears; tank capacity and spray distance are limited

- **trombone or slide** – reaches further than compressed air sprayers, but is harder to use; chemicals are carried in a separate container

- **garden hose** – used for small orchards; easy to use and sprays a fair distance

  NOTE: The trombone and garden hose are "leakers" and may leak liquids during application.

MOTORIZED

- **small motorized sprayers** – may have all the components of a larger field sprayer but must be pulled or towed; may be low-pressure or high-pressure; suitable for small orchards

  NOTE: These sprayers may be mounted on wheels so they can be pulled by hand; mounted on a trailer to be pulled behind a tractor; or placed on a skid to be carried on a small truck.

- **airblast** – flushes air from trees and replaces it with water carrying pesticides (other types of sprayers use only liquid to carry the chemical to the plant or object); most are trailer-mounted, but some may be tractor-mounted; they may spray an area up to 90 feet wide and trees up to 70 feet tall; some disadvantages include high costs, drift hazards, not suitable for windy conditions, hard to use in small areas

- **low pressure sprayers** – designed to spray diluted or concentrated liquid chemical over large areas; usually mounted on tractors or trucks and send out a low to moderate volume of spray (10 to 60 gallons per acre); cost less than high-pressure sprayers but have limited spray penetration and reach

- **boom sprayers** – low pressure sprayers often have sprayer booms that range from 10 to 60 feet long; the height of the sprayer boom must be easily adjusted to the type of job

- **boomless sprayers** – low-pressure sprayers without booms usually are equipped with a nozzle that sends out a horizonal spray; spray can move through narrow places and avoid trees and other obstacles

- **high pressure sprayers** – used to spray through dense foliage and to the tops of high trees and other places where high penetration is needed; can deliver large volume of spray (often 20 to 500 gallons per acre); usually mounted on tractors, trailers, trucks, or may move on their own; may produce fine droplets that drift easily, cost more than low-pressure sprayers, and use a great deal of water power and fuel

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⚠ **WARNING:** Herbicides should not be used in mist blowers.

NOTE: High-pressure sprayers are also called hydraulic sprayers.

AERIAL

- **fixed wing** – a plane that carries pesticides (or fertilizers) and distributes the chemical by air over the crop; application can be an advantage when the ground is too wet to use other equipment; application is quick and requires no labor or equipment by the owner, however, in bad weather the aircraft may not be able to fly
- **rotary wing** – pesticides, etc. are dropped over the target area by helicopter

OBJECTIVE 24

Match types of animal controls to the animals.

NOTE: Check with your local game warden or resource management agency what animals are protected in your area and whether trapping or shooting are legal.

- **mice, squirrels and chipmunks** – generally not protected, but check with officials to be sure; use mouse traps for mice and rat traps for ground squirrels and chipmunks; peanut butter and chocolate work better than cheese; set traps near nest openings and place large piece of chicken wire over trap
- **rabbits** – use chicken wire that is three feet wide; the bottom six inches is bent outward from the garden and covered with about one inch of soil; the top 30 inches is supported; rabbits can often clear 24 inches of fencing, but not 30 inches; the buried six inches prevents rabbits from digging under the fence

  Other options include dusting plants that rabbits have started feeding on with baby powder; feeding should stop immediately; redust after rain or heavy dew

  The fungicide Thiram can be found in some commercial animal chaser or repellents. This material has a bad taste and usually after the first bite the animal leaves the plants alone. Follow label directions and precautions.

- **deer** – try deodorant soap; cut the bars of soap in half and place the bars about 30 inches above ground on wooden stakes; about one inch from the top of the stake, drive a nail through the wood and push the half bar of soap on to the nail

  NOTE: Do NOT hang the soap on fruit trees since mice seem to like the taste of the soap. The mice will feed on the soapy bark after the rains.

- **birds** – for large birds such as crows, blow-up snakes can be effective; five-foot snake can protect about a 10-foot diameter of vine crops or a berry patch of about nine bushes or 10 square feet; snakes must be moved daily or birds quickly learn that the snake is a fake; tie snake to the upper part of the plants one day, on the ground the next day, etc.; scare-eye balloons and cellophane tape may be effective

  Strawberry farmers may use "berry bombs" to scare birds from their crops.

  Netting draped over trees, or netting stretched over a frame surrounding berry crops may also protect fruit. However, this method may not be practical for large-scale crops.

  NOTE: The Migratory Bird Act comes into play here. Robins, jays, etc., are protected, so it is important to check with regulatory officials before disturbing or killing birds.

- **gophers** – plowing in the spring and fall will upset their habitats.

ASSIGNMENT SHEET 1

Development of:
MATHEMATICS SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why mathematics and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  MATHEMATICS

  - Estimating answers
  - Converting units of measure
  - Solving word problems
  - Using English & metric measures
  - Solving ratio/proportion problems
  - Solving practical problems

  EMPLOYABILITY

  - Mastering a specific job task/procedure

- If students have difficulty estimating answers:
  - Remind students of situations in which they already estimate answers, such as during division or when budgeting and shopping.
  - Have students identify criteria on which the estimate can be based.
  - Have students suggest upper and lower limits of reasonable possibility, then work from them to an estimate.

- If students have difficulty converting units of measure:
  - Review and compare units being used.
  - Review and compare relationships between units.
- If students have difficulty solving word problems or with solving practical problems:
  - Instruct them to find the key elements of the problem.

    EXAMPLES: Measurements given, what the problem is asking, information given.
  - Have students identify relationships between given information and the solution.
  - Review indicated mathematical functions.
- If students have difficulty using English and metric measures:
  - Suggest that they look at measuring tools marked in English, metric or both and study the measurements until there is a concrete idea about each unit of measurement.
  - Have students convert measurements to become accustomed to their relative sizes.
  - As work progresses, have students make measurements in one system, estimate the measurement in units of the other system, then convert the measurement or remeasure using the other system.
- If students have difficulty solving ratio/proportion problems:
  - Review the basic principles for finding ratio and proportion.
  - Demonstrate that ratio and proportion can be expressed in fractions. Demonstrate that measurements such as "1/2 cup" is actually a ratio between the measurement needed and the measurement of one cup.
  - Stress that in working with ratios, the first term is represented by the first number, the second word by the second number, etc.

    EXAMPLE: Use a 1:12 ratio of concentrate to water: 1 represents the amount of concentrate, 12 represents the amount of water.

- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

ASSIGNMENT SHEETS 2 & 3

Development of:
MATHEMATICS SKILLS
SCIENCE SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why mathematics, science, and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  MATHEMATICS

  - Calculating with whole numbers
  - Calculating with fractions
  - Solving formulae and equations
  - Converting units of measure
  - Solving word problems
  - Selecting/applying mathematical procedure
  - Using English & metric measures
  - Solving time/rate/distance problems
  - Solving ratio/proportion problems
  - Applying algebra principles

SCIENCE

- Investigating/applying physical laws

EMPLOYABILITY

- Mastering a specific job task/procedure

- If students have difficulty calculating with whole numbers:
  - Review basic skills in addition, subtraction, multiplication, and division.
  - Review mathematical terminology.

    EXAMPLE: "Compare" is an indication that you must subtract.
  - Remind students that people are often more capable of solving math problems than they realize. Suggest they simplify problems by changing the "setting" of the problem.

    EXAMPLE: If the problem calls for adding and subtracting acreage, have the student use the same figures, but think of their checkbooks. Additions are deposits, subtractions are checks or fees.
- If students have difficulty calculating with fractions:
  - Review basic skills in addition, subtraction, multiplication, and division of fractions.
  - Review terms and procedures for finding common denominators and converting fractions.
  - Review converting fractions to decimals or percentages and completing the problems.
- If students have difficulty solving formulae and equations:
  - Discuss the importance of learning mathematical formulae.
  - Review the mathematical formulae that are relevant.
  - Take them through the basic order for solving formulae and equations or refer them to a basic math or algebra text that is easy to read and understand.

- If students have difficulty selecting and applying math procedures:
  - Instruct the students to reword the problem in a form that is clearer to them.
  - Review the mathematical procedures that are relevant to this assignment.
  - Review mathematical terminology.
- If students have difficulty solving time/rate/distance problems:
  - Suggest they construct a simple chart to help them visualize the problem.

EXAMPLE:

TIME	RATE	DISTANCE
2 hrs	60 mph	120 miles
1 hr	60 mph	60 miles
3 1/4 hrs	60 mph	195 miles

  - Instruct them to examine the relationship between time, rate, and distance.
  - Discuss the fact that this is a skill that is used daily in life.
- If students have difficulty applying algebra principles:
  - Remind students that they use algebra daily. For example, if they order a pizza delivery of two pizzas at $6.99 each plus $.95 for an extra topping on each, three salads at $2.97, a pitcher of soda at $1.49, and a delivery fee of $2.00, use a $2.00 coupon, then divide the total bill equally among three people, they are actually solving the algebra problem:

$$X = \frac{[2(a+b) + 3c + d + e] - f}{g}$$

where a = cost of pizza
b = cost of extra topping
c = cost of salad
d = cost of a pitcher of soda
e = delivery fee
f = value of coupon
g = number of people chipping in

- Have students identify each variable.
- Have students identify known relationships between variables.
- Review terminology.

- If students have difficulty investigating/applying physical laws:
  - Review the concepts, symbols, and principles involved.
  - Demonstrate the law in a simple manner.
  - Discuss the principles involved using situations already familiar to students.
- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheet 1.

OBJECTIVE 25

Compute problems involving wet and dry measurements.

INTRODUCTION

When you use pesticides and herbicides you will be measuring and mixing various amounts of dry or liquid chemicals. This means you need to know how to convert ounces to cups, pints, quarts or gallons, or calculate teaspoons into tablespoons and tablespoons into ounces. You should also know dry measurements, such as how many grams in an ounce.

DIRECTIONS

Operation and Calculation Skills
- Estimate answers
- Converts unit of measure

Math Application Skills
- Solve word problems
- Use English & metric measures
- Solve ratio/proportion problems

Job Acquisition/ Development Skills
- Master specific job task/procedure

The following table will give you measurements equivalents. If you cook, you may already be familiar with many of these measurements! Study the table, and then answer the problems that follow.

LIQUID EQUIVALENTS

1 gallon = 4 quarts = 128 ounces
1 quart = 2 pints = 32 ounces
1 pint = 2 cups = 16 ounces
1 tablespoon = 3 teaspoons
16 tablespoons = 1 cup = 8 ounces
1 fluid ounce = 29.5 milliliters
1 tablespoon = 15 milliliters = 1/2 fluid ounce

DRY EQUIVALENTS

1 pound = 16 ounces = 454 grams
1 ounce = 28.25 grams

1. You must spray your apple trees for disease control. You have three acres of apples. The pesticide package says to use 10 ounces per acre. Approximately how many pints would you need to spray the orchard?

2. The directions on the chemical label say to use 1 tablespoon per one gallon of water. You need to mix up 20 gallons. How many ounces of the chemical do you need? Approximately how many cups would that be?

3. The directions on the label call for 3 ounces of pesticide per gallon of water and you want to prepare 80 gallons. What is the amount of pesticide you need in quarts? How many pints are remaining?

4. The directions on the label call for 3 grams per liter and you want to make 10 liters. How much pesticide would you need to use (in grams)? Approximately how many ounces is this?

5. The label call is for 2 pounds of pesticide per 100 gallons of water. Your tank holds 500 gallons. How much pesticide (in pounds) do you need to use? How much is this in ounces?

OBJECTIVE 24 **Calibrate an air sprayer.**

INTRODUCTION

Calibration is easy and very important. If you do not calibrate properly, you may use too little herbicide, making it ineffective, or you may use too much which can damage plants and crops. You must know how much the sprayer is applying per acre so that you know how much herbicide to put in the tank.

Before an air sprayer can be calibrated, there are several important factors to know and check. The equipment should be able to do the job intended, and tractors must be able to maintain uniform ground speed based on terrain. Also, equipment must be in good working order, gauges should be operational, and tank, lines, and manifolds free of rust, etc.

1. When given the *gallons per acre application*, use the following formula to determine the sprayer delivery rate (GPM) required:

$$GPM = \frac{GPA \times R \times MPH}{495}$$

Where:

GPM = gallons per minute for both sides of sprayer
GPA = gallons per acre
R = distance between rows (feet)
MPH = miles per hour

2. When given the *nozzling arrangement*, use the following formula to determine the gallons per acre applied.

$$GPA = \frac{GPM \times 495}{R \times MPH}$$

Where:

GPA = gallons per acre
GPM = gallons per minute from both sides of sprayer
R = distance between rows (feet)
MPH = miles per hour

Operation and Calculation Skills

- Calculate with whole numbers
- Calculate with fractions
- Solve formulae & equations
- Converts units of measure

Math Application Skills

- Solve word problems
- Select and apply mathematical procedure
- Use English & metric measures
- Solve time/rate/distance problems
- Solve ratio/proportion problems
- Apply algebra principles

Physical Science Skills

- Investigate/apply physical laws

Job Acquisition/ Development Skills

- Master specific job task/procedure

3. When *calibrating tractor speed* for tractors without a speedometer, use the following formula:

$$\text{MPH} = \frac{\text{T x S}}{\text{M x 88}}$$

Where:

T = number of trees
MPH = miles per hour
M = time of test run in minutes
S = tree spacing in feet

4. To determine the amount of material in pounds to add per tank, use this equation:

$$\text{P} = \frac{\text{C x MPA}}{\text{GPA}}$$

Where:

P = pounds of material per tank
C = tank capacity in gallons
MPA = pounds of material per acre needed
GPA = gallons per acre

EXAMPLES:

a. A grower wants to apply 500 gallons of water per acre travelling at 2 mph in an orchard with 25 feet between rows of trees. The sprayer has 10 nozzles per side. Determine the gallons per minute required.

$$\text{GPM} = \frac{\text{GPA X R X MPH}}{495} = \frac{\text{500 X 25 X2}}{495} = \frac{25{,}000}{495} = 50.5 \text{ GPM}$$

b. A grower's sprayer delivers 14 GPM and has a tank capacity of 400 gallons. The grower will travel 3 MPH and tree rows are 20 feet apart. The handbook recommends 2 pounds per acre. How many pounds of material should the grower put in the tank?

$$\text{P} = \frac{\text{C X MPA}}{\text{GPA}}$$

C = 400 gallons
MPA = 2 pounds per acre
GPA = unknown

Find GPA and then solve for P.

$$\text{GPA} = \frac{\text{GPM X 495}}{\text{R X MPH}} = \frac{\text{14 X 495}}{\text{20 X 3}} = \frac{6930}{60} = 115.5$$

$$\text{P} = \frac{400 \times 2}{115.5} = 6.9$$

c. The trees in the orchard are 10 feet apart in the row. In 2 minutes, the tractor passes 25 trees. How fast is the tractor traveling?

$$\text{MPH} = \frac{T \times S}{M \times 88} = \frac{25 \times 10}{2 \times 88} = \frac{250}{176} = 1.4$$

Now for the exercises:

1. A grower wants to apply 400 gallons per acre and is traveling at 2 MPH. There is 22 feet between each row of trees. How many gallons per minute are applied?

2. The sprayer delivers 12 GPM and has a capacity of 300 gallons. The person applying the water is travelling at 3 MPH. The rows are 25 feet apart. The handbook recommends 2 pounds of material per acre. How many pounds of material must be put in the tank? (Remember, you must first calculate gallons per acre.)

3. The trees in the orchard are 15 feet apart. In 2 minutes, the tractor passes 30 trees. How fast is the tractor traveling?

4. A grower wants to apply 250 gallons per acre and is travelling at 1.5 MPH in an orchard with 20 feet between rows. How many gallons per minute are applied?

5. The sprayer delivers 14 GPM and has a tank capacity of 400 gallons. The vehicle is traveling at 2.5 MPH and the rows are 20 feet apart. The handbook recommends 3 pounds of material per acre. How many pounds of material must be put in the tank?

6. The trees in the orchard are 20 feet apart. In 3 minutes, the tractor passes 30 trees. How fast is the tractor traveling?

ASSIGNMENT SHEET 3 — CONTROL PESTS IN FRUIT AND NUT PRODUCTION — VIII

OBJECTIVE 27 **Calibrate a boom sprayer.**

INTRODUCTION

As in air sprayer calibration, it is important that the boom sprayer be in good working condition. The pressure gauge should be operational, the pressure regulator should keep a uniform pressure, and tank, lines, and nozzles should be clean. A rate of 50 gallons of water per treated acre is recommended.

Operation and Calculation Skills
- Calculate with whole numbers
- Calculate with fractions
- Solve formulae & equations
- Converts units of measure

Math Application Skills
- Solve word problems
- Select and apply mathematical procedure
- Use English & metric measures
- Solve time/rate/distance problems
- Solve ratio/proportion problems
- Apply algebra principles

Physical Science Skills
- Investigate/apply physical laws

Job Acquisition/ Development Skills
- Master specific job task/procedure

1. To determine the output of all nozzles, use this equation:

$$GPM = \frac{GPA \times S \times B}{43560}$$

GPA = gallons per treated acre
GPM = gallons per minute
S = tractor speed in feet per minute
(1 MPH = 88 feet per minute)
B = treated band width in feet

2. To determine application rate based on boom discharge rate, use this equation:

$$GPA = \frac{GPM \times 43560}{S \times B}$$

GPA = gallons per treated acre
GPM = boom discharge rate in gallons per minute
S = tractor speed in feet per minute
B = width of treated area in feet

3. All nozzles should have the same discharge rate and the boom should be nozzled according to the following equation:

$$R = \frac{GPM}{N}$$

R = individual nozzle discharge rate
GPM = boom application rate in gallons per minute
N = number of nozzles on the boom

4. To determine the amount of material to add per tank, use this equation:

$P = \frac{C \times MPA}{GPA}$ P = pounds of material per tank

C = tank capacity in gallons

MPA = pounds of material per acre needed

GPA = gallons per acre

Here are some figures to help you:

1 MPH = 88 ft/min.

2 MPH = 176 ft/min.

3 MPH = 264 ft/min.

4 MPH = 352 ft/min.

5 MPH = 440 ft/min.

EXAMPLE:

a. A grower wants to apply an herbicide using 50 GPA of water and a tractor speed of 3 mph. The boom has 4 nozzles and treats an 8-foot bank of ground. How much water must each nozzle deliver per minute?

$$GPM = \frac{50 \times 264 \times 8}{43560} = \frac{105600}{43560} = 2.4$$

R = 2.4 = .6 GPM per nozzle

b. A grower has a boom sprayer with 3 nozzles delivering .6 gpm each. The boom will spray a band 6 feed wide and the tractor will travel 4 mph. The sprayer has a 200 gallon tank and the herbicide application is 4 pounds per treated acre. How many pounds of herbicide should be put in each tank?

$$GPM = .6 \times 3 = 1.8$$

$$GPA = \frac{1.8 \times 43560}{352 \times 6} = \frac{78400}{2112} = 37.1$$

$$P = \frac{200 \times 4}{37.1} = 21.6 \text{ pounds per tank}$$

Here are the exercises:

1. The grower wants to apply an herbicide using 55 GPA of water. The tractor is traveling at 4 MPH. The boom has 2 nozzles and treats a 6 foot band of ground.

   a. What is the output of all nozzles per minute?

   b. What is the output of each nozzle per minute?

2. The grower has a boom sprayer with 3 nozzles delivering .5 GPM each. The boom will spray a bank 5 feet wide and the tractor will travel 2 MPH. The sprayer has a 100 gallon tank and the herbicide must be applied at a rate of 4 pounds per treated acre.

   a. How many gallons per minute do all nozzles deliver?

b. How many gallons per treated acre will be applied?

c. How many gallons of herbicide should go into each tank?

3. The tractor is traveling 4 MPH and the sprayer is putting out 25 gallons per acre. The tank holds 200 gallons and there are 4 nozzles. The sprayer treats a 6 foot band of ground.

   a. What is the output of all nozzles in gallons per minute?

b. What is the discharge rate of each nozzle?

c. If the sprayer has 150 gallon tank and the herbicide needs to be applied at 3 pounds per treated acre, how many pounds of herbicide should be put in each tank?

ASSIGNMENT ANSWERS

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

ASSIGNMENT SHEET 1

1. 2
2. 10 ounces; one cup plus 2 ounces
3. 7 quarts; 1 pint
4. 30 grams; approximately one ounce
5. 10 pounds; 160 ounces

ASSIGNMENT SHEET 2

1. 35.56 gallons per minute
2. 7.58 pounds
3. 2.56 MPH
4. 15.15 gallons per minute
5. 8.66 pounds
6. 2.27 MPH

ASSIGNMENT SHEET 3

1. a 2.67
   b. 1.33
2. a. 1.5
   b. 74.25
   c. 5.39
3. a. 1.21
   b. .3
   c. 18 pounds per tank

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

JOB SHEET 1

Development of:
READING SKILLS
MATHEMATICS SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, mathematics, and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  MATHEMATICS

  - Calculating with whole numbers
  - Solving ratio/proportion problems
  - Making measurements
  - Solving practical problems

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely, including effect on crops and safety considerations.
  - Have them read the instructions several times, noting the key words and ideas.

- If students have difficulty using English and metric measures or making measurements:
  - Review the units of measure in the English and metric systems.
  - Demonstrate the correct way to measure using the specific measuring instrument.
  - Have students estimate units of measure and then measure their estimates.
  - Provide simple measuring exercises using the units of measure in the job sheet for practice.
- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.
  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment.
  - Discuss what behaviors and attitudes constitute good work habits.
  - Make sure the student knows what is expected of him or her.
- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheets 1 and 2.

JOB SHEET 2

Development of:
READING SKILLS
MATHEMATICS SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why mathematics, science and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

MATHEMATICS

- Making measurements

EMPLOYABILITY

- Mastering a specific job task/procedure
- Practicing good work habits/attitudes

- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheet 1 and Job Sheet 1.

JOB SHEET 3

Development of:
READING SKILLS
WRITING SKILLS
SCIENCE SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, writing, science and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

READING

- Following written instructions

WRITING

- Stating ideas clearly

SCIENCE

- Collecting specimens
- Identifying/classifying living organisms

EMPLOYABILITY

- Mastering a specific job task/procedure
- Practicing good work habits/attitudes

- If students have difficulty stating ideas clearly:
  - Suggest they have their thoughts organized before they begin writing.
  - Review the information noting the key words and ideas.
  - Discuss the importance of stating the ideas clearly.
  - Instruct them to use simple concise words.
- If students have difficulty collecting specimens:
  - Review procedure for collecting samples.
  - Explain the necessity for keeping samples separate and labeled, and uncontaminated.
  - Review reasons and practices for determining an effective sampling.
  - Allow students to practice collecting samples before completing the job sheet.
- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheet 1 and Job Sheet 1.

JOB SHEET 1 — CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

OBJECTIVE 28 **Calibrate a hand-held sprayer.**

INTRODUCTION

It is important to calibrate or know the rate of spray from your sprayers before you start, otherwise you could damage or kill plants with too much spray, or not get any results because not enough liquid is applied. There are several ways to calibrate sprayers depending on the type of equipment.

TOOLS AND MATERIALS

- String or garden hose
- Water
- Sprayer
- Herbicide

PROCEDURE

Yes No

1. Mark off 100 square feet. Use a string or garden hose to mark off the area. ____ ____

2. Fill your tank full of water and spray the 100 square feet just as you would if you were spraying with a chemical. Be sure to walk the same speed and use the same pressure as you will when spraying with herbicide. Also be sure to walk on the same type of surface you are going to spray. If you keep track of the time it takes (in seconds) to spray the specified area and don't vary that time when you apply the chemical, you will get a more even application. Remember, you only need to lightly wet the plants. ____ ____

3. Measure how much water is needed to refill the spray tank. ____ ____

   NOTE: If you multiply the amount of water used to refill the tank by 10, you will determine the amount needed to cover 1,000 square feet. Many recommendations are given per 1,000 square feet. When actually spraying an area with herbicide, use the same pressure and walk the same speed as when you calibrated.

Functional Reading Skills
- Follow written instructions

Operation and Calculation Skills
- Calculate with whole numbers

Math Application Skills
- Use English & metric measures

Functional Match Skills
- Make measurements
- Solve practical problems

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
4. Put away tools and clean work area.	____	____
5. Have instructor check your work.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Marked area accurately	4	3	2	1
Filled tank	4	3	2	1
Wetted plants	4	3	2	1
Calculated amount of water to refill tank	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training

3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required

2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill

1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 2

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

OBJECTIVE 29

Clean spray equipment after pesticide use.

INTRODUCTION

Many pesticides are corrosive and will eat away at plastic and metal parts. Some chemicals are held in suspension while the sprayer is in operation, but will settle out and harden if left standing. The sprayer should be thoroughly cleaned after each use.

TOOLS AND MATERIALS

- Sprayer
- Shovel
- Water
- Detergent
- Cup grease or pipe compound
- Protective clothing – unlined neoprene gloves and boots, neoprene apron, face shield, long-sleeved shirt, and pants or disposable coveralls

PROCEDURE

NOTE: Be sure that equipment used to spray pesticides is not used for other types of spraying such as fertilizing.

Functional Reading Skills
- Follow written instructions

Operation and Calculation Skills
- Calculate with whole numbers

Math Application Skills
- Solve ratio/proportion problems

Functional Match Skills
- Make measurements
- Solve practical problems

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

1. Determine a site to be used and label the site. ____ ____

   NOTE: Burying pesticides can cause water problems or contamination concerns.

2. Fill sprayer tank with water and detergent according to chart: ____ ____

Container size	Water	Detergent
5 gallons	2 quarts	2 Tablespoons
30 gallons	3 gallons	1/2 cup
55 gallons	5 gallons	1 cup

3. Let mixture sit in container for 15 minutes, stirring or agitating periodically. ____ ____

	Yes	No
4. While waiting, disassemble nozzles, strainers, and screen.	____	____
5. Wash nozzles, strainers, and screen with detergent.	____	____
6. Dump sprayer tank rinse onto labeled site.	____	____
7. Flush tank with water at least three times, dumping waste onto site.		
8. Allow parts to dry thoroughly.	____	____
9. Coat threads with cup grease or pipe compound to prevent the joints from "freezing."	____	____
10. Reassemble sprayer.	____	____
11. Put away tools and equipment and cleaned work area.	____	____
12. Have instructor check your work.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ______________________________

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Selected site	4	3	2	1
Filled sprayer	4	3	2	1
Flushed tank	4	3	2	1
Dried parts	4	3	2	1
Reassembled sprayer	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 3 — CONTROL PESTS IN FRUIT AND NUT PRODUCTION — VIII

OBJECTIVE 30

Collect and submit a plant specimen for disease identification.

TOOLS AND MATERIALS

- Shovel or other digging tool
- Plants to study
- Dry paper towels
- Plastic bag
- Specimen container for shipping

INTRODUCTION

The best way to diagnose a plant disease problem is to submit a good specimen with accurate and detailed information to the local cooperative extension office. Most cooperative extension programs offer services for disease diagnosis. Check with your local extension office for precise information on what to submit and where to send the specimen. The following is a general guideline for collecting and packaging a sample.

PROCEDURE

	Yes	No
1. Collect the entire plant if possible, by digging it out of the ground and leaving some soil on the roots. Do NOT pull the plant out of the ground. If you cannot submit the entire plant, include as many parts of the plant that show the symptoms.	____	____
2. Take specimens from several plants to get a representative sample of the disease. Be sure the sample is large enough to give an accurate sample.	____	____
3. Collect specimens as soon as possible before submitting them keeping them cool and moist.	____	____
4. Place green leaves between dry paper towels and put them in a plastic bag. Leave the bag unsealed to allow air to circulate. Ship the specimen in a container that protects leaves.	____	____

Functional Reading Skills
- Follow written instructions

General Science Skills
- Collect specimens

Life Science Skills
- Identify/classify living organisms

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
5. Place roots in a plastic bag with moist soil, or some other material that will keep them from drying.	____	____
6. Wrap fruit or fleshy specimens separately in paper and place them in an unsealed plastic bag without added moisture.	____	____
7. Write down as much information as you can about the specimen. Give the scientific name and common name of the plant if possible. Describe how you have been caring for the plant, when you discovered the disease, and other information that may help identify the pest or disease.	____	____
8. Check with the extension office or plant science department of a local university for the name and address of the person who does the diagnosis. Address the package containing the samples to that person.	____	____
9. Clean work area and put tools and equipment away.	____	____
10. Have instructor check your work.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Collected sample	4	3	2	1
Number of specimens	4	3	2	1
Moisture of specimens	4	3	2	1
Wrapping of specimens	4	3	2	1
Information about specimens	4	3	2	1
Addressed package	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

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WRITTEN TEST

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

Name ____________________ Score __________

OBJECTIVE 1

Match terms associated with controlling diseases, pests and weeds to their correct definitions. Write the letter of the correct answer in the blanks.

Part I

___ 1. The practice of holding pest numbers or their damage below the point where their presence would cause economic loss

___ 2. The ability of a poison to produce adverse effects

___ 3. Powdery or cobweb-like growth of fungus, usually found on leaves

___ 4. Kills all it comes in contact with

___ 5. Poisonous

___ 6. A dead area on a stem surrounded by living tissue

___ 7. Applied before weed seeds germinate and kill the weeds as they germinate

___ 8. Stripping of leaves

___ 9. Capable of bursting into flames

a. selective

b. toxic

c. mildew

d. preemergence herbicides

e. combustible

f. systematic

g. canker

h. chlorophyll

i. defoliate

j. toxicity

k. integrated pest management

l. nonselective

May be photocopied for student use.

Part II

___ 1. Inside and moving throughout the plant

___ 2. Affecting specific plants or specific parts of plants

___ 3. Applied to small emerging weeds that are actively growing

___ 4. Food materials, pesticide, or herbicide moved from one part of the plant to another

___ 5. The rapid discoloration and death of tissues on certain areas of plants; may be caused by an air or soil condition, or by an insect

___ 6. A substance that oozes or discharges from the plant

___ 7. Measuring and adjusting the amount of pesticide a piece of equipment will apply to a specific area

___ 8. Green substance found in plants

___ 9. Any plant growing where it is unwanted

a. selective

b. blight

c. systemic

d. preemergence herbicides

e. blight

f. translocated

g. postemergence herbicides

h. weed

i. calibration

j. nonselective

k. chlorophyll

l. exudate

OBJECTIVE 2

Select from a list true statements concerning components of integrated pest management. Write an "X" in the blank before each correct statement.

___ 1. IPM works to safeguard human health while preserving the balance of nature

___ 2. IPM relies on a calendar schedule for treating pests and diseases

___ 3. IPM relies solely on the use of chemicals to rid crops of pests and diseases

May be photocopied for student use.

___ 4. IPM uses field scouts to check crops regularly to determine the kinds and numbers of pests and beneficial organisms present

___ 5. IPM makes use of several pest control alternatives such as chemicals, cultural practices, plant resistance, and natural controls

___ 6. IPM involves higher costs because of the need to get rid of all pests at any cost

OBJECTIVE 3

Select from a list true statements concerning pesticide classifications. Write an "X" in the blank before each correct statement.

___ 1. Class I pesticides are relatively non-toxic

___ 2. Class II pesticides are moderately toxic

___ 3. Class IV pesticides are relatively non-toxic

___ 4. Class III pesticides are highly toxic

___ 5. Class II pesticides pose a threat to humans, animals, or the environment, even when used as directed

___ 6. Class III pesticides are not likely to harm humans, animals, and the environment when used as directed

___ 7. Class I pesticides are classified as "Restricted Use"

___ 8. Class IV pesticides use the identification symbol: "WARNING"

___ 9. Class III pesticides use the identification symbol: "CAUTION"

___ 10. Class I pesticides use the identification symbol: "DANGER" and "POISON" with a skull and crossbones

May be photocopied for student use.

OBJECTIVE 4 **Distinguish between acute and chronic toxicity.** Write "A" in the blanks before statements about acute toxicity and "C" in the blanks before statements about chronic toxicity.

___ 1. Symptoms may appear within a week or toxic buildup can take many years before symptoms appear.

___ 2. Refers to how poisonous a chemical is after one exposure.

___ 3. Can occur after a single small or large exposure.

___ 4. Occurs over a period of time.

___ 5. People who load chemical products, work in the same building with toxic materials, mix chemicals, or work in chemically treated fields can develop this type of toxicity.

___ 6. Symptoms develop quickly, within a few minutes or within a few hours.

___ 7. Refers to how poisonous a chemical is after repeated small doses.

OBJECTIVE 5 **Define oral, dermal and inhalation toxicity.** Write your answers in the blanks.

1. Oral toxicity – ______________________________

____

2. Dermal toxicity – ______________________________

____

3. Inhalation toxicity – ______________________________

____

May be photocopied for student use.

Match pesticide information to a sample pesticide label. Write the correct names in the blanks.

PRECAUTIONARY STATEMENTS
⑨

DANGER

⑩ HAZARDS TO HUMANS (& DOMESTIC ANIMALS)

Poisonous by swallowing or inhalation. Do not breathe spray mist. Do not get in eyes. Avoid contact with skin. Wear a mask or respirator of a type passed by the U.S. Bureau of Mines for De Pesto protection. For emergency assistance call 000-000-0000

TO PHYSICIAN: Do not use oximes such as 2-PAM. Give Atropine 2mg. intravenously or subcutaneously. If in eye instill one drop of Homatrophine

ENVIRONMENTAL HAZARDS ⑪

This product is toxic to fish, birds and other wildlife. Birds feeding on treated areas may be killed. Keep out of any body of water. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes. This product is toxic to bees and should not be applied when bees are actively visiting the area

⑫ PHYSICAL OR CHEMICAL HAZARDS

WARNING – Flammable! Keep away from heat or open flame

⑬ DIRECTIONS FOR RESTRICTED USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling

RE ENTRY STATEMENT ⑭

Do not enter area within five days after application

CATEGORY OF APPLICATOR ⑮

For use only by agricultural pest control applicators.

⑯ STORAGE AND DISPOSAL DIRECTIONS

STORAGE – Store in original container. Do not store next to food or other articles intended for consumption by humans or animals

DISPOSAL – Do not reuse container. Destroy by burying in a safe place

OR

Contact State or Regional Federal Authorities for local restrictions on disposal

①

RESTRICTED USE PESTICIDE

FOR RETAIL SALE TO AND APPLICATION ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.

② **PEST-A-WAY**

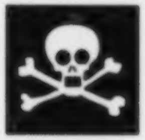
③ ACTIVE INGREDIENT:	*Pestzapper ④	40.50%
INERT INGREDIENTS:		59.50%
TOTAL:		100.00%

*Betabugazene ④

This product contains 0.5 lbs of Pestzapper per gallon.
Pestzapper is a registered trademark of Weedy Corporation.

KEEP OUT OF REACH OF CHILDREN

⑤ **DANGER — POISON**



⑥ STATEMENT OF PRACTICAL TREATMENT

IF SWALLOWED – Induce vomiting by giving a tablespoon of salt in a glass of warm water. Repeat until vomitus is clear. Call a physician immediately

IF INHALED – Remove to fresh air. Call physician immediately

IF IN EYEs – Flush eyes with plenty of water for at least 15 minutes. Call a physician immediately

IF ON SKIN – In case of contact, remove contaminated clothing and immediately wash skin with soap and water.

SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS

⑦ MFG BY WEEDY CHEMICALS
TOWN, STATE, USA

⑧ ESTABLISHMENT NO. 0816-YZ-4
EPA REGISTRATION NO. 1033-34

⑬ DIRECTIONS FOR RESTRICTED USE CONTINUED

BLUEBERRIES: For use in controlling the 3-horned berry slurper. Refer to chart and apply recommended amount when pests appear. Observe indicated number of days before harvesting. Do not apply more than once per season

MINIMUM GALLONAGE REQUIREMENT: Three gallons of mixed spray per acre with ground equipment, one gallon per acre with aircraft

⑰ NET CONTENTS ONE GALLON

May be photocopied for student use.

1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

6. ____________________

7. ____________________

8. ____________________

9. ____________________

10. ____________________

11. ____________________

12. ____________________

13. ____________________

14. ____________________

15. ____________________

16. ____________________

May be photocopied for student use.

OBJECTIVE 7

Select from a list true statements concerning rules for pesticide storage. Write an "X" in front of each correct statement.

___ 1. Storage area should be childproof.

___ 2. Storage area should be air-tight.

___ 3. Chemicals should be poured into new containers before storing.

___ 4. Storage area should be down-wind and downhill from sensitive areas such as houses, animal shelters, gardens, etc.

___ 5. Storage area should be securely locked and identified with warning signs.

___ 6. Leaking containers and old chemicals should be disposed of.

___ 7. Location of hazardous chemicals must be on file at city hall.

___ 8. Herbicides, insecticides, fungicides, etc., may be stored next to each other in the storage area.

___ 9. Chemicals should not be accepted without their MSDSs.

OBJECTIVE 8

Complete statements regarding types of diseases that affect fruit and nut production. Write your answers in the blanks.

1. **Fungal** – Lower plant forms that lack ____________________, true roots, stems and leaves; parasites which live on organisms or feed on dead organic material. Fungus diseases reproduce by microscopic ______________________________ that are carried through the air, by rain, or by insects; often microscopic, but can be seen when present in large quantities; can usually be controlled through fungicide spraying programs

2. **Bacterial** – _____________________ -celled microorganisms that have no chlorophyll; bacteria is difficult to control by ________________________ and the usual control method is to burn plants or remove infected areas and disinfect the pruning wounds

May be photocopied for student use.

3. **Viral** – ultra ______________________ organisms that cause various diseases in plants; cannot be controlled directly by spraying; are best battled by cross-breeding to develop resistant varieties of plants and controlling insects that transmit viruses.

4. **Physiological** – diseases attributed to ________________ problems such as poor ______________________, adverse weather, poor grafting, etc.

OBJECTIVE 9

Match common types of pesticides used in fruit and nut production to their correct descriptions. Write the letter of the correct answer in the blanks.

___ 1. Kills insects
___ 2. Kills or repels spiders, mites, and ticks
___ 3. Kills nematodes
___ 4. Kills small rodents that feed on crops or seeds
___ 5. Kills bacteria
___ 6. Prevents fungi
___ 7. Kills some pests while not affecting others
___ 8. Kills or repels birds that harm or destroy crops
___ 9. Kills mites
___ 10. Insecticide made from dried, powdered chrysanthemum flowers
___ 11. Kills all pests
___ 12. Selective or nonselective material for killing weeds or preventing weed seed germination

a. acaricide
b. amoebacide
c. selective pesticide
d. omnicide
e. insecticide
f. nonspecific pesticide
g. rodenticide
h. nonselective pesticide
i. specific pesticide
j. bactericide
k. avicide
l. prometheus
m. herbicide
n. miticide
o. nematicide
p. fungicide
q. pyrethrum

May be photocopied for student use.

OBJECTIVE 10

Match common diseases of pecans to their correct descriptions. Write the letter of the correct answer in the blanks.

___ 1. Bushy growths of slender, willowy shoots; this is because the disease forces growth into the lateral buds

___ 2. Leaves turn yellow, become twisted, and later reddish-brown; causes twigs and limbs and, eventually, tree to die; caused by zinc deficiency, usually from alkaline or low-zinc soils

___ 3. Small, dark, circular, olive to black spots on foliage and nuts; if not controlled, crops and some trees could be lost when there are frequent rains or extended dew (This is the time when spores germinate on leaflets, twigs, and nut shucks.)

___ 4. Large galls on roots and bases of trunk

___ 5. Powdery white growth on nuts, foliage; may cause nuts to stay small, shucks to split early, and kernels to shrivel

a. spot

b. scab

c. mold

d. powdery mildew

e. rosette

f. bunch disease

g. canker

h. twig bunch

i. crown gall

May be photocopied for student use.

OBJECTIVE 11

Match common diseases of apples and pears to their characteristics. Write the letter of the correct answer in the blanks.

Part I

___ 1. Shiny, black dots in clusters of 10 to 50 and look like flyspecks; usually occurs with sooty blotch

___ 2. Blossoms appear water-soaked and wilt, turning brown; shoots wilt from the tip and turn dark, as if scorched by fire; the end of the shoot bends into a crook shape; bacteria can kill a young tree

___ 3. Spots form under skins of fruit and later turn brown and rot in storage; caused by lack of or reduced calcium and fluctuating amounts of water in growing season

___ 4. Small purple specks on leaves which grow to dark spots with yellowish centers (frogeyes); may cause fruit to shrivel into black "mummies" that hang on tree throughout winter

___ 5. Small light brown spots on fruit enlarge and darken, turning almost black; saucer-shaped depression forms in center

a. bitter rot

b. bitter pit

c. botrytis

d. fire blight

e. brownrust

f. rosette

g. flyspeck

h. black rot

May be photocopied for student use

Part II

___ 1. Occurs on leaves, fruit, and sometimes twigs; starts as pale yellow spots on leaf surface that grow and turn orange; on underleaf, orange-yellow, tube-like structures called aecia form in each spot; on fruit, lesions appear near the calyx end and are larger than leaf lesions

___ 2. Attacks one-year-old shoots, including foliage, blossoms, and fruit; small, white spots appear on underside of leaves, enlarging to cover the surface; black spots develop in the white area; blossoms infected by the fungus will not produce fruit, and already formed fruit will be malformed

___ 3. On leaves, appears as green to brown spots that darken with age; causes leaves to drop early; on fruit, infection becomes brownish-black and corky; fruit may look scabby, knotty, or misshapen

___ 4. Caused by soil-borne fungus; blackened, cankered area develops on ground area of main trunk; gummy exudate is found under dead bark; bark on infected area dries and canker becomes more visible; often causes tree to die

___ 5. Appears as a smudgy appearance; usually occurs with flyspeck

a. collar rot

b. crown gall

c. cedar apple rust

d. gray rot

e. powdery mildew

f. sooty blotch

g. scab

h. bitter pit

May be photocopied for student use.

OBJECTIVE 12

Match common diseases of peaches, nectarines, and plums to their correct descriptions. Write the letter of the correct answers in the blanks.

___ 1. Patches of white, or sometimes grayish or brown fungus; immature fruits are highly susceptible and have brown blotches that are scabby and malformed

___ 2. Puckered, curled, distorted leaves; thicker than other leaves; infected leaves turn yellow or brown and drop; infected fruits get irregular, bumpy areas; fruit usually drops prematurely

___ 3. Small, white spots on fruit; spots grow quickly and may cover entire fruit; flesh turns spongy and seed stops developing, turns brown and withers; fruit becomes larger than normal and inside dries up, leaving only a shell

___ 4. Small, round, blackish spots on fruit about six weeks after petal fall; cracking may occur; twigs get yellow-brown blotches, outlined in gray or blue; leaf spots are brown; holes appear as leaves dry out

___ 5. Round, small red spots on leaves that turn brown in the center and drop out, leaving holes; on twigs, dark blisters turn into cankers; on fruit, spots turn into dark saucer-shaped depressions with gummy yellow exudate

___ 6. Small, brown spots appear on fruit as it nears maturity; moisture makes spots enlarge and grayish-white tufts appear on skin

a. Root rot

b. Peach scab

c. Brown rot

d. Fungal spot

e. Leaf pocket

f. Peach leaf curl

g. Plum pocket

h. Ring blight

i. Bacterial spot

j. Powdery mildew

May be photocopied for student use.

OBJECTIVE 13

Match common diseases of small fruits to their correct descriptions. Write the letter of the correct answer in front of each question. You may use the same answer more than once.

Part I

___ 1. On your strawberry plants, there are spots about 1/4 inch in diameter that started out dark purple, and later turned dark brown, giving a "scorched" appearance. The fruit does not appear to be forming properly. What might the disease be?

___ 2. On your grape vines, reddish-brown spots appeared on upper leaf; these enlarged and merged to create blotches with tannish-brown centers and a darker outline. The fruits have shriveled to black "mummies." What might the disease be?

___ 3. On your strawberry plants, there is stunting, yellowing, gradual withering and dying of plants. You suspect that something has infected the roots. What might the disease be?

___ 4. On your blackberries, the young shoots are spindly and the leaves are pale green to yellow; in spring, the underside of leaves covered with orange powdery spores. What might the disease be?

___ 5. On your grape vines, the fruit, young shoots, tendrils, petioles and leaf veins have small sunken spots with dark borders; leaves appear ragged and distorted. What might the disease be?

___ 6. On your grape vines, there is a fuzzy, gray growth on fruit and leaves after some cool, wet weather. What might the disease be?

a. botrytis

b. leaf scorch

c. brown rot

d. black rot

e. leaf spot

f. orange rust

g. grape anthracnose

h. powdery mildew

i. red stele and verticillium wilt

May be photocopied for student use.

Part II

___ 1. On your blackberry plants, there are small, ashy spots on canes, especially near bottom; there are also spots on leaves and fruits and fruit "mummies." What might the disease be?

___ 2. On your grape vines, pale, yellow spots are on the upper leaf and a white coating appears on underside; the spots have started turning brown and the young fruit has stopped growing and turned dark and dry. What might the disease be?

___ 3. On your blackberries, there are round swellings on roots and on canes; these galls look soft and white. What might the disease be?

___ 4. On your blackberries, there is a white, powdery substance on stems, leaves, and berries; the plants are in dry soil. What might the disease be?

___ 5. On your strawberry plants there are circular spots, up to 1/4 inch on upper leaf; spots are purplish-red turning to gray to white centers with purplish borders. The plants were infected during cool, wet weather when the leaves were young. What might the disease be?

___ 6. On your blackberries, the fruits have decayed and shriveled into "mummies"; the fruits and blossoms are also covered with gray mold. What might the disease be?

a. anthracnose
b. leaf spot
c. brown rot
d. downy mildew
e. crown gall
f. botulism
g. botrytis
h. powdery mildew
i. orange rust

May be photocopied for student use.

Part III

___ 1. The blossoms are dying on your strawberry plants and the fruit is rotting and turning brown as it starts to ripen; this has occurred after a dense growth of foliage and rainy weather while the fruit is ripening. What might the disease be?

___ 2. On your grape vines, there are white, powdery patches on leaves, young canes, and fruit. What might the disease be?

___ 3. On your blueberry plants, gray or brown cankers appeared and then the stems died back and caused leaves to brown and wither. What might the disease be?

___ 4. On your blackberry plants, several leafy shoots developed from infected buds; shoots are smaller than normal and have pale green foliage that turns bronze; petals on the infected flower buds are pinkish, wrinkled and twisted, giving a "double" appearance. What might the disease be?

___ 5. On your blueberry plants there are round swelling on roots and a few soft white galls on the canes. What might the disease be?

___ 6. On your blueberry plants there is a white powdery substance on stems, leaves, and berries. The plants are in dry soil. What might the disease be?

a. crown gall
b. powdery mildew
c. leaf scorch
d. gray mold
e. botrytis
f. anthracnose
g. rosette
h. orange rust
i. leaf spot

May be photocopied for student use.

OBJECTIVE 14

Match common insect pests of pecans trees to their correct descriptions. Write the letter of the correct answer in the blanks.

Part I

___ 1. Light-brown or grayish beetle about 1/2 inch long with a long beak; it attacks the nut; adults feed on kernels before the shell is hard; larvae feed on partially matured nuts; holes in the shells may be noticed

___ 2. Grayish-brown beetles, 1/2 inch to 5/8 inch long, with reddish heads and long antennae; adult insect often girdles the twigs in late summer and in fall, causing injured branches to break off or hang loosely from trees

___ 3. Infestations may cause defoliation and reduce the nut crop; causes bright-yellow rectangular areas on leaves, which eventually turn brown and the leaf drops

___ 4. Look for crusted scales on branches; they feed on the plant sap under the visible shield; infested leaves often drop; branches get weak and die

___ 5. Small sucking insects that cause tumor-like swellings of galls to appear on leaves, leafstalks, succulent shoots, and nuts of new growth. The most damaging species causes malformed, weak shoots that eventually die

a. twig girdler
b. walnut caterpillar
c. pecan weevil
d. San Jose scale
e. boll weevil
f. phylloxera
g. inchworm
h. aphids

May be photocopied for student use.

Part II

____ 1. Feeds in groups, often eating all the leaves on small trees or individual limbs of large trees; full-grown caterpillars are black, two inches long and covered with dirty-white or gray hairs

____ 2. Caterpillars which produce large, dirty-white webs on trees in late summer and fall; control is needed only when pests are numerous in a grove, but webs should be knocked down when caterpillars are small

____ 3. Insects that pass the winter in cocoons found where the bud joins the stem; they become active in the spring, feeding on buds and then boring into young shoots; newly hatched insects do the most damage, attacking newly-set nuts; infested nuts are recognized by silken threads that hold them together

____ 4. Whitish caterpillars up to 1/2 inches long that feed on the interior of immature nuts. Later in the season, the tunnel into the shucks; a powdery white stain around entry points on nut may be visible

a. walnut caterpillar

b. pecan nut casebearer

c. pecan weevil

d. fall webworm

e. hickory shuckworm

f. phylloxera

May be photocopied for student use.

OBJECTIVE 15

Match common insect pests of fruit and nut trees to their correct descriptions. Write the letter of the correct answer in the blanks.

Part I

___ 1. Attack trunk and branches of stone fruits, particularly peaches; adults emerge mid-May to September and lay eggs on bark; larvae then hatch and must get under loose bark for protection; eventually girdle and kill tree

___ 2. Small insects that feed on sap, cause stunted growth; usually found in clusters on buds, leaves, and tips of shoots of fruit trees

___ 3. Attacks orchard fruits, including apple, peach, plum, pear, and cherry; insect is a dark-brown beetle that feeds on newly forming fruits; eggs are laid in the skin; larvae tunnels through fruits causing fruit to drop or rot

___ 4. Attacks apples, other orchard fruit, and strawberries; mites are extremely small, and are best seen with a magnifying glass; they are often found on the underside of leaves; they suck juices from the leaves causing the foliage to turn yellow and then brown

___ 5. Attack all kinds of fruit trees; feed on branches, leaves and fruits, causing red, spotted areas; infested leaves often drop, branches get weak and die

a. borers

b. San Jose scale

c. aphids

d. drillers

e. plum maggot

f. plum curculio

g. grasshopper

h. red mites and two spotted mite

May be photocopied for student use.

Part II

___ 1. Small, brightly colored insects that chew leaves and produce tiny white spots and sickly appearing plants

___ 2. Attacks apples; lives during the winter behind loose bark on the tree; moths lay their eggs on leaves and fruit; the larvae damage apples by chewing their way into the core of apples, that tunnel opens the way for diseases

___ 3. Also called plant bugs; feed on young fruit and can affect fruit development and leave deep, unsightly depressions in fruit; problem is particularly prevalent in stone fruits

___ 4. Casement of webbing can hold hundreds of larvae near branch tips; tips will be defoliated; caterpillars are black, 1/2 inch to 1 1/4 inches and are "leaf chewers"; adults are moths about 1/2 inch long with light yellow or red/brown wings about 1 to 1 1/3 inches long

___ 5. In the spring, larvae bore into young shoots, causing them to die; later in the season, larvae feed on fleshy part of fruit and exit through holes in sides; there may be a gummy exudate at exit hole; when full grown, they are 1/2 inch, and a pink color; peaches are most severely damaged

a. tent caterpillar

b. black mites

c. cat-facing insects

d. Aphids

e. borers

f. leaf hoppers

g. oriental fruit moth

h. coddling moth

May be photocopied for student use.

OBJECTIVE 16

Match common insect pests of small fruits to the damage they cause. Write the letter of the correct answer in the blanks.

___ 1. Cause grayish, speckled, or yellow leaves

___ 2. Feeds on flesh of fruit leaving holes and sometimes removes seeds

___ 3. Sticky, dark bark; small, dark raised spots on underside of leaves; sometimes black patches on leaves

___ 4. White or gray, cottony fluff on stems

___ 5. Weak growth, hollow stems on old canes and holes where insects have left

___ 6. Feeds inside the plant near the soil, weakening or killing the plant; kills the plant by feeding on the roots

___ 7. Suck sap from leaves causing them to become curled and stunted; weaken plant and may transmit viral disease

___ 8. Cuts off buds, leaves, and fruit and leaves them hanging as if they had been partly broken off

___ 9. Chews leaves

___10. Folds leaves and the caterpillars eat inside

a. ants

b. red spider mite

c. aphids

d. scale insects

e. pill bugs

f. mealy bugs

g. fruit borer

h. leaf folders

i. japanese beetles, other beetles, caterpillars

j. june bugs

k. black spider

l. strawberry weevil or clipper

m. strawberry beetle

n. crown borer

o. cane borer

May be photocopied for student use.

OBJECTIVE 17

Describe methods of controlling pests. Describe any seven methods given on the information sheet. Write your answers in the blanks.

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

5. ______________________________

6. ______________________________

May be photocopied for student use.

7. ______________________________

____

____

____

OBJECTIVE 18

Define annual, biennial, and perennial weeds. Write your answers in the blanks.

1. Annual – ______________________________

____

____

2. Biennial – ______________________________

____

____

3. Perennial – ______________________________

____

____

OBJECTIVE 19

List three examples of the various types of grass and broadleaf weeds. Write your answers in the blanks.

1. Annual grasses:

   a. ______________________________

   b. ______________________________

   c. ______________________________

2. Perennial grasses:

   a. ______________________________

   b. ______________________________

   c. ______________________________

May be photocopied for student use.

3. Annual broadleaf:

   a. ______________________________

   b. ______________________________

   c. ______________________________

4. Perennial broadleaf:

   a. ______________________________

   b. ______________________________

   c. ______________________________

5. Woody perennial broadleaf:

   a. ______________________________

   b. ______________________________

   c. ______________________________

OBJECTIVE 20

Describe methods of controlling weeds without using chemicals. Give six of the eight methods listed in the information sheet. Write your answers in the blanks below.

1. ______________________________

____

____

2. ______________________________

____

____

3. ______________________________

____

____

May be photocopied for student use.

4. ______________________________

____

____

5. ______________________________

____

____

6. ______________________________

____

____

OBJECTIVE 21

Define the three types of herbicides. Write your answers in the blanks.

1. Contact herbicides – ______________________________

____

____

2. Translocated herbicides – ______________________________

____

____

3. Preemergence herbicides – ______________________________

____

____

OBJECTIVE 22

Complete statements regarding the correct principles in selecting and using herbicides for weed control. Write your answers in the blanks.

1. Know the weed ______________ before choosing a herbicide.

2. Read the label for __________________ approval, precautions for applying the herbicide, _______of crop development for chemical application, limitations, and directions for use.

May be photocopied for student use.

3. Newly registered herbicides or a herbicide new to the ____________ should be tried on a ______________ area the first time to allow the grower a chance to see the effects of the chemical.

4. Apply at the suggested rate for your ________________ type and for the stage of crop or weed development. Apply the herbicide evenly, accurately, and at a ______________ rate.

5. Know the best application ________________ for each herbicide, depending on whether it is preemergence or _________.

6. Know factors that affect herbicide _________.

OBJECTIVE 23

Match types of equipment used to apply pesticides to their correct descriptions. Write the letter of the correct answer in the blanks.

___ 1. Designed to spray diluted or concentrated liquid chemical over large areas; usually mounted on tractors or trucks and send out a low to moderate volume of spray

___ 2. Pesticides, etc. are dropped over the target area by helicopter

___ 3. Can be used on most crops except large trees such as pecans, apples, and pears; tank capacity and spray distance are limited

___ 4. Used to spray through dense foliage, to the tops of high trees, and other places where high penetration is needed; they can deliver large volume of spray

a. Garden hose

b. Trombone or slide

c. compressed air sprayer

d. mist sprayer

e. small motorized sprayers

f. airblast

g. low pressure sprayers

h. boomless sprayers

i. stationary sprayer

j. sprinkler

k. high pressure sprayers

l. rotating sprayer

May be photocopied for student use.

___ 5. Low pressure sprayers often have sprayer booms that range from 10 to 60 feet long; the height of the sprayer boom must be easily adjusted to the type of job

___ 6. A plane that carries pesticides (or fertilizers) and distributes the chemical by air over the crop.

___ 7. Reaches further than compressed air sprayer, but harder to use; chemicals are carried in a separate container

___ 8. Flushes air from trees and replaces it with water carrying pesticides

___ 9. Used for small orchards; easy to use and sprays a fair distance

___ 10. May have all the components of a larger field sprayer but must be pulled or towed; may be low-pressure or high-pressure; suitable for small orchards

___ 11. Low pressure sprayers without booms that usually are equipped with a nozzle that sends out a horizonal spray; spray can move through narrow places and avoid trees and other obstacles

m. rotary wing

n. maximum pressure

o. fixed wing

p. free air sprayer

q. boom sprayers

May be photocopied for student use.

OBJECTIVE 24

Match animals with the potential types of controls. Place the correct letter in each blank. You may use the same letter more than once.

___ 1. Try deodorant soap placed on wooden stakes

___ 2. Blow-up snakes that are moved daily

___ 3. Chicken wire that is about three feet high; about six inches is buries and the top 30 inches are supported

___ 4. Traps set near nest openings with a large piece of chicken wire over the trap

___ 5. Dust plants that the animals have fed on with baby powder

___ 6. Berry bombs

___ 7. Netting draped over trees

___ 8. The fungicide Thiram

___ 9. Plowing in the spring and fall

M = mice, squirrels, and chipmunks

R = rabbits

D = deer

B = birds

G = gopher

NOTE: Objectives 25 through 30 are evaluated on assignment sheets/job sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

CONTROL PESTS IN FRUIT AND NUT PRODUCTION

VIII

OBJECTIVE 1

Part I

1. k
2. j
3. c
4. l
5. b
6. g
7. d
8. i
9. e

Part II

1. c
2. a
3. g
4. f
5. b
6. l
7. i
8. k
9. h

OBJECTIVE 2

1, 4, 5

OBJECTIVE 3

2, 3, 5, 6, 7, 9, 10

OBJECTIVE 4

1. C
2. A
3. A
4. C
5. C
6. A
7. C

OBJECTIVE 5

1. Oral toxicity – Poisoning in or through the mouth
2. Dermal toxicity – Poisoning on or through the skin
3. Inhalation toxicity – Poisoning by breathing in fumes or particles

OBJECTIVE 6

1. Use classification
2. Trade or brand name
3. Ingredient statement
4. Common and chemical names
5. Signal word and symbols
6. Statement of practical treatment
7. Name and address of manufacturer
8. Registration and establishment number
9. Precautionary statement
10. Hazards to humans and domestic animals
11. Environmental hazards
12. Physical or chemical hazards
13. Directions for use
14. Re-entry statement
15. Category of applicator
16. Storage and disposal directions
17. Net contents

OBJECTIVE 7

1, 4, 5, 6, 9

OBJECTIVE 8

1. chlorophyll, spores
2. one, spraying
3. microscopic, cross-breed
4. natural, nutrition

OBJECTIVE 9

1.	e	6.	p	11.	h
2.	a	7.	c	12.	m
3.	o	8.	k		
4.	g	9.	n		
5.	j	10.	q		

OBJECTIVE 10

1.	f
2.	e
3.	b
4.	i
5.	d

OBJECTIVE 11

Part I		**Part II**	
1.	g	1.	c
2.	d	2.	e
3.	b	3.	g
4.	h	4.	a
5.	a	5.	f

OBJECTIVE 12

1.	j
2.	f
3.	g
4.	b
5.	i
6.	c

OBJECTIVE 13

Part I	Part II	Part III
1. b	1. a	1. d
2. d	2. d	2. b
3. i	3. e	3. f
4. f	4. h	4. g
5. g	5. b	5. a
6. a	6. g	6. b

OBJECTIVE 14

Part I	Part II
1. c	1 a
2. a	2. d
3. h	3. b
4. d	4. e
5. f	

OBJECTIVE 15

Part I	Part II
1. a	1. f
2. c	2. h
3. f	3. c
4. h	4. a
5. b	5. g

OBJECTIVE 16

1. b	6. n
2. m	7. c
3. d	8. l
4. f	9. i
5. o	10. h

OBJECTIVE 17

Answers should include any seven of the following.

- **Spraying** – involves the application of chemicals in liquid form to prevent or combat attacks by insects and diseases.
- **Dusting** – is the application of chemicals in dust form to plants to prevent or combat attacks by insects and diseases.
- **Natural controls** – can be used to control some pests. Some insects and diseases can be controlled by natural means, without human assistance. Examples are temperatures, moisture or light that is unfavorable to certain pests and diseases, or species that are resistant to these problems. In addition, certain insects can be introduced into an orchard or field to control destructive fungi, bacteria, or other pests.
- **Destroying or burning** – Orchard pests often live through the winter in plant debris such as leaves, old fruit and pruned branches; clearing and burning this debris will help control insects, diseases, and other pests such as mice and rabbits.
- **Mechanical guards** – such as fences and wire guards around the base of trees and plants can help prevent injury from mice, rabbits and other animals.
- **Sanitation** – Can reduce the incidence of certain pests. Packing and storage areas need to be kept clean to keep insects such as coddling moths that have overwintered in old boxes and crates from returning in the spring
- **Crop rotation** – helps control the buildup of pests that are known to attack a certain crop.
- **The use of sterilized insects** – Can help reduce insect pests. Releasing sterilized male insects of certain species can reduce the population of those problem insects
- **Nursery inspection** – Can keep diseased or insect-infested plants from reaching the fields. Infested or diseased stock should be destroyed.
- **Selection of resistant varieties** – helps control pest damage.

OBJECTIVE 18

1. **Annual** – completes its life cycle in one season
2. **Biennial** – can store food for a second year of growth
3. **Perennial** – lives for more than two seasons

OBJECTIVE 19

Answers should include any three grasses or weeds for each of the following:

1. Annual grasses – goosegrass, crabgrass, witchgrass
2. Perennial grasses – nutsedge, bermudagrass, johnsongrass, quackgrass
3. Annual broadleaf – carpetweed, redroot pigweed, cocklebur, chickweed, wild mustard, henbit, jimsonweed
4. Perennial broadleaf – dandelion, morning glory, dock, horse nettle
5. Woody perennial broadleaf – poison ivy, trumpetcreeper, japanese honeysuckle, wild blackberries

OBJECTIVE 20

Answers should include any six of the following:

Use of insects and disease-causing agents attack the unwanted species of weeds.

Grazing by sheep, goats, or geese is usually used to control weeds along ditches, roadsides, and fences.

Tillage often used to kill or control weeds in row crops. However, tillage may bring buried seeds to the surface where they can germinate and compete with crops.

Reduced tillage reduces weed growth without turning up as many weed seeds or causing as much erosion.

Mowing may be used to reduce weeds and to prevent annual or biennial weeds from flowing and seeding. It is often used in orchards to control weeds and prevent soil erosion.

Burning may help control annual and biennial weeds. However, it destroys only the above-ground parts of plants and is not effective against many herbaceous perennial weeds.

Mulching is used to prevent light from reaching the weed seeds, thus preventing the weeds from growing.

Time of planting can help control weeds. Crops planted inn the spring compete well against winter annual weeds. Sometimes a planting date can be delayed until after weeds have sprouted and have been removed by cultivation and/or herbicides.

Cover crops eliminate the "bad" weeds by planting other grass or vegetation that will compete with them.

OBJECTIVE 21

1. **Contact herbicides** -- kill foliage, but have little or no effect on plant roots. Annuals can usually be killed with one application but it may take several applications for perennials.
2. **Translocated herbicide** -- Kills all parts of the plant from the leaves to roots
3. **Preemergence herbicide** -- applied to the soil and kills germinating seedlings

OBJECTIVE 22

1. species
2. registration, stage
3. user, small
4. soil, uniform
5. time, postemergence
6. performance

OBJECTIVE 23

1. g
2. m
3. c
4. k
5. q
6. o
7. b
8. f
9. a
10. e
11. h

OBJECTIVE 24

1. D
2. B
3. R
4. M
5. R
6. B
7. B
8. R
9. G

OBJECTIVE SHEET

HARVEST FRUIT AND NUTS

IX

INTRODUCTION

Harvesting fruit and nut crops is enjoyable because you are finally seeing the results of many months of nurturing. But like many other aspects of fruit and nut production, care and timing are critical. Fruits must be harvested at the proper time to maintain their nutrients as well as their freshness and quality. A grower's profits depend on correct harvesting. Many crops are now harvested by machine, but in small or backyard orchards, hand-picking is still common.

UNIT OBJECTIVE

After completing this unit, the student will know advantages and disadvantages of mechanical harvesting, know how to determine when to harvest various crops, and know types of equipment and containers used in harvesting fruits and nuts. In addition, the student will be able to hand-pick apples, pears, and strawberries. The student will demonstrate these competencies by completing the job sheets and the written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with harvesting fruit and nut crops to their correct definitions.
2. Select from a list factors that help determine optimum harvest maturity.
3. Complete sentences about determining when to harvest various fruit and nut crops.
4. Match various fruit and nut crops to their annual yield estimates.
5. Describe types of mechanical equipment used in harvesting.
6. List advantages and disadvantages of mechanical harvesting.
7. Name types of containers used in harvesting tree fruits and small fruits.
8. Hand-pick an apple or pear. (Job Sheet 1)
9. Hand-pick strawberries from the plant. (Job Sheet 2)

SUGGESTED ACTIVITIES

HARVEST FRUIT AND NUT

IX

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with harvesting fruit and nut crops to their correct definitions.

- Discuss terms; when possible, use examples to illustrate terms.

Objective 2: Select from a list factors that help determine optimum harvest maturity.

- Show students examples of pressure (or firmness) testers.

Objective 3: Complete sentences about determining when to harvest various fruit and nut crops.

Objective 4: Match various fruit and nut crops to their annual yield estimates.

- Discuss factors that help determine optimum harvest maturity; show examples of each.

- Display examples of fruits and nuts in various stages of maturity; have students select which fruits are at optimum harvest maturity and explain why.

- Discuss yield estimates, explaining the various factors that can influence the size of the crop. Examples: pruning, fertilizing, irrigation, and such unknowns as pest infestation and drought.

- Talk to local growers to find out how they estimate annual yields and how these figures help in determining such factors as profit, how many containers to purchase, and how to sell the crops.

- Compare yields of various crops on the West Coast, Midwest, and Eastern states. Discuss why there are such variations.

Objective 5: Describe types of mechanical equipment used in harvesting.

Objective 6: List advantages and disadvantages of mechanical harvesting.

Objective 7: Name types of containers used in harvesting tree fruits and small fruits.

- Display brochures showing examples of mechanical equipment on the market; discuss the possibility of renting machinery as opposed to purchasing it.

- Give students examples of small and large fruit production operations; ask them whether they think it would be more economical to purchase the equipment or hand-pick the crop.

- Discuss mechanical versus hand-picked fruit and nut crops. Invite a representative from an orchard or farm machinery company to discuss improvements made in harvesting equipment over the years. Talk about which crops are still primarily hand-picked.

- Discuss labor costs; find out the average salary for fruit pickers in your area. Have students compute how much it will cost a grower to harvest a crop based on average annual yield (Objective 4) and labor costs.

- Show examples of containers used in harvesting crops; if possible, show examples of containers that are obsolete and discuss why.

- Discuss the costs of various containers; have students find out the costs of containers for a particular crop, and then have them determine container costs for an average annual yield, using estimates in Objective 4.

- Talk about the possibility of reusing containers -- particularly in a pick-your-own operation where fruit can be transferred from containers into less expensive paper or plastic bags.

- Have a grower or representative from a machinery or packaging firm discuss containers and machinery used in harvest.

- Take students "behind the scenes" at a local market to show them how produce arrives at the market. Discuss whether these are the same containers that were used for picking the fruit.

APPLICATION

Objective 8: Hand-pick an apple or pear.

Objective 9: Hand-pick strawberries from the plant.

- Bring in samples of apples, pears, strawberries from the local grocery store. Show students how stems are still intact on the majority of fruits.

- Have students practice hand-picking apples, pears, and strawberries.

- Have students complete Job Sheets 1 and 2.

EVALUATION

Pretest

- Give written test as pretest.

- Determine individual study requirements from pretest results.

- Counsel students individually on pretest results and study requirements.

- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.

- Evaluate students on job sheet activities.

- Complete appropriate section of competency profiles.

- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.

- Give the written test.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

- *Pecan Production in the Southeast, A Guide for Growers* (Circular ANR-459). Alabama Cooperative Extension Service: Auburn University, AL, 1989.
- Ryugo, Kay. *Fruit Culture: Its Science and Art.* John Wiley and Sons, Inc.: New York, NY, 1988.

UNIT REFERENCES

Print Media

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- Childers, Norman F. *Modern Fruit Science.* Horticulture Publications: Gainesville, FL, 1983.
- Childers, Norman F. *The Peach.* Rutgers - The State University: New Brunswick, NJ, 1974.
- *Fruits and Berries.* The American Horticultural Society: Mount Vernon, VA, 1982.
- McEachern, George Ray, *Growing Fruits, Berries & Nuts in the South.* Gulf Publishing Company: Houston, TX, 1978.
- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction: Des Moines, IA, 1982.

- Reiley, Edward H., and Carroll L. Shry Jr. *Introductory Horticulture*, 3rd edition. Delmar Publishers Inc: Albany, NY, 1988.
- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.
- Schmidt, James C. *"Harvesting Fruits."* Cooperative Extension Service, University of Illinois, College of Agriculture: Urbana-Champaign, IL, 1984.

INFORMATION SHEET — HARVEST FRUITS AND NUTS — IX

OBJECTIVE 1 **Match terms associated with harvesting fruit and nut crops to their correct definitions.**

- **bushel** — unit of dry measurement equal to 32 quarts
- **full bloom** — period when the first petals begin to fall
- **ground color** — color of the flesh on the bottom of the fruit
- **maturity** — stage of development in fruits or nuts when eating or processing quality is at its best
- **spur** — short, woody stem or branch that is the main fruiting area for most fruit trees
- **ton** — unit of weight equal to 2,000 pounds
- **water core** — disorder of a fruit that gives the area near the core a watery or glassy appearance

OBJECTIVE 2 **Select from a list factors that help determine optimum harvest maturity.**

- Flesh color
- Seed color
- Ground color or undercolor of the skin

  EXAMPLE: With many apple varieties the ground color changes from a leaf green color and becomes lighter, usually a yellowish color.

- Number of days from full bloom

  EXAMPLE: Studies show that the Delicious variety of apple takes from 145 to 150 days from full bloom to reach picking maturity.

- Pressure test — A thin slice of the skin is removed and a hand-operated pressure tester records the resistance of the tissue to crushing (or flesh firmness).
- Sugar (soluble solids) content, or sugar/acid ratio in grapes

  NOTE: This factor is most important in small fruits.

OBJECTIVE 3

Complete sentences about determining when to harvest various fruit and nut crops.

- **Apples** – A good indication that harvest time is near is when normal fruit begins to **drop**. The **ground** color of the fruit should turn from green to yellow-green. A taste test will also help indicate if the **starches** are turning to sugar.

  NOTE: Apples picked too soon are likely to be small, poorly colored, sour, tough, off-flavor, and subject to diseases such as bitter pit and scald. Overripe apples may develop water core while still on the tree or break down after picking. They taste like potatoes (very high starch and low sugar).

- **Peaches** – The fruit is ripe when it separates easily from the **twigs** on the tree. Pick them when the ground color changes from green to yellow. The skin of yellow-fleshed varieties gets an **orange** tint; the skin of white-fleshed varieties turns from greenish to **yellowish-white.**

- **Pears** – Pears are best when harvested in a slightly "**green**" stage. Look for color change – from green to yellow, change in flesh firmness, and change in soluble solids, all of which show a change in **sugar** content. Another indication is when the **stem** separates easily from the tree. Size may also be a factor in picking because the shipper or buyer may require a certain size.

- **Plums** – A **color change** is noted, depending on the variety. For example, blue or purple varieties change from green to greenish-blue or reddish-purple to dark blue or purple. As the color increases the flesh becomes slightly **soft**, especially at the tip end.

- **Strawberries** – Harvest when the berry is fully colored. **White** areas indicate it is not fully ripe. At least **75** percent of the berry surface must be red or pink in color to attain U.S. grade No. 1. First harvest occurs about **30** days after bloom. Berries should be kept out of the sun and refrigerated as soon as possible. Early morning picking is recommended because temperatures are cooler. Harvest on alternate days.

- **Blackberries** – Pick when the fruit becomes soft and **sweet** and comes off easily in the hand. Berries that are black but hard to remove from the cluster may be **sour**. Berries should be picked in the early morning so as not to spoil as quickly. Harvest at least every **third** day.

- **Blueberries** – A fully ripe berry will have **uniform** color and should come loose from the plant easily. A **reddish** ring around the "scar" or indentation where the fruit is attached to the stem, means the berry is not ripe. Harvest at **weekly** intervals.

- **Grapes** – Ripeness is best determined by **color and flavor.** The natural bloom on the grape will become noticeable, and the berries will become slightly less **firm**. The fruit should be handled as little as possible and care should be taken not to crush it.

  NOTE: Grapes should not be picked until they are fully ripe because they will not develop full flavor if harvested before they are mature. Table grapes are generally picked by hand while juice and wine grapes are picked by machine.

- **Pecans** – Ripen in mid-September through **December**. Crop can be harvested as **shucks** begin to open.

OBJECTIVE 4 **Match various fruit and nut crops to their annual yield estimates.**

It is useful to know how much fruit can be expected each year to help in estimating orchard profits. For fruit trees, an orchard estimator may look at the trees at three different times: after the crop set, after the June drop, and about one month before harvest.

Remember, you must also take into account the density of the plantings, variety and age of the fruit or nut crop, and maintenance factors such as irrigation, pest control, and fertilization.

- Apples – 300 to 600 bushels per acre (mature orchard)
- Pecans – Up to 1000 pounds per acre from mature tree (15 years old)

  NOTE: Native pecans will produce 400 to 700 pounds per acre.

- Pears – 20 to 30 tons per acre
- Peaches – 200 to 400 bushels per acre
- Plums – 3 to 5 tons per acre
- Cherries (sour) – Up to 1,200 pounds per acre (from both young and full-bearing trees)
- Grapes – Up to 6 tons per acre (full-bearing vines)

  NOTE: This is about 0.65 tons per acre in Texas (wine grapes)

- Blueberries – 5,000 to 7,000 pounds per acre
- Blackberries – 6,000 to 8,000 pounds per acre

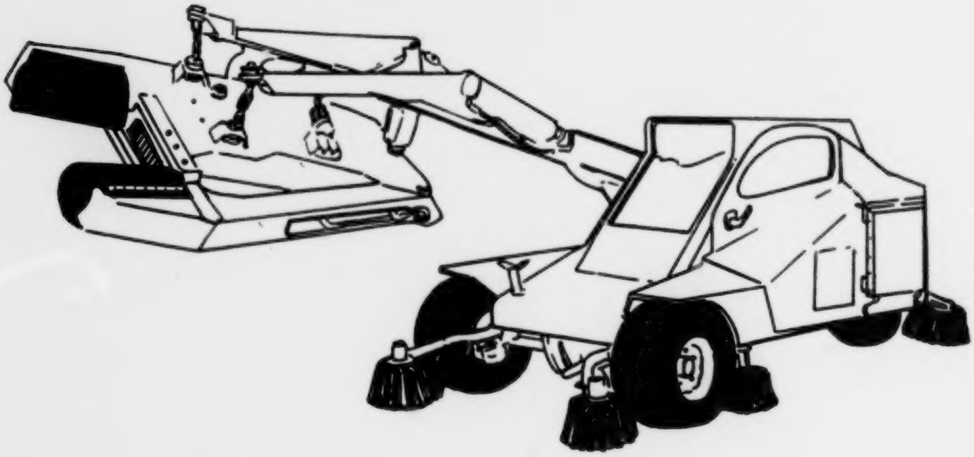
- Strawberries — 8,000 to 11,000 pounds per acre

NOTE: The above estimates are primarily for Eastern states; crop yields are often higher in California.

OBJECTIVE 5 **Describe types of mechanical equipment used in harvesting.**

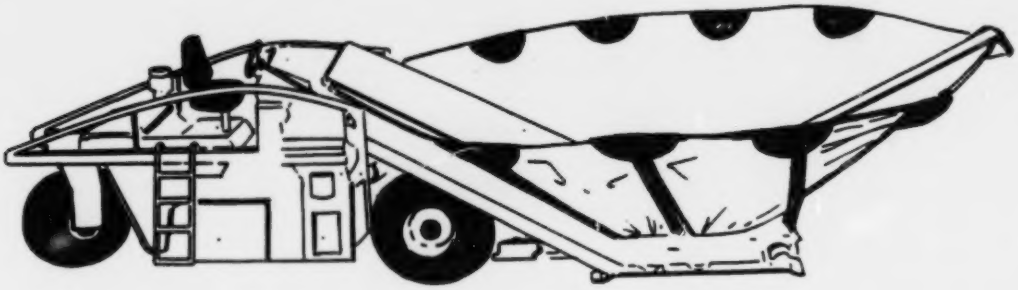
The type of machine used in harvest operations will vary with the size and type of the operation, the type and variety of fruit, topography of land, and means of processing. A pick-your-own operation, for example, will probably require little mechanical investment. Blueberries, blackberries, and grapes may also be harvested with special machinery such as an over-row harvester. This harvester straddles the row and dislodges fruit using vibrating tines.

- **shakers** — mechanical devices that attach to the limbs or trunks of trees to shake fruits or nuts loose



Courtesy of Orchard Machinery Corporation, Yuba City, CA.

- **catching frames** – devices that catch and convey the fruits or nuts to bins



Courtesy of Orchard Machinery Corporation, Yuba City, CA.

- **pickup machines** (sweepers) – collect fruits or nuts that have fallen to the ground
- **mechanical aids** – devices such as fixed position platform and movable tower attached to a boom; used to help workers collect fruit
- **forklift** – used to carry bins or boxes from field to packing house

OBJECTIVE 6 **List advantages and disadvantages of mechanical harvesting.**

Advantages:

- May be cost-effective when labor is scarce or expensive.
- Machinery may pay for itself over an extended period of time, despite a large initial investment.

Disadvantages:

- Some types of fruits are picked more than once, depending on maturity; may be costly to move equipment through fields several times.
- Area of the orchard floor must be clear of obstacles such as tree props.
- High costs of machinery and upkeep may not make it profitable.
- Equipment for shaking and collecting may damage some fruits and nuts.

- Equipment may not collect all fruit on trees or plants.

- Equipment is somewhat non-selective in terms of fruit maturity, so grower may be left with some fruit that was picked too soon.

OBJECTIVE 7

Name types of containers used in harvesting tree fruits and small fruits.

The types of containers used in harvesting will depend on the types of fruits and nuts, and the size and type of the operation. These items should be ordered well in advance of harvest season to make sure they are available and on hand when needed.

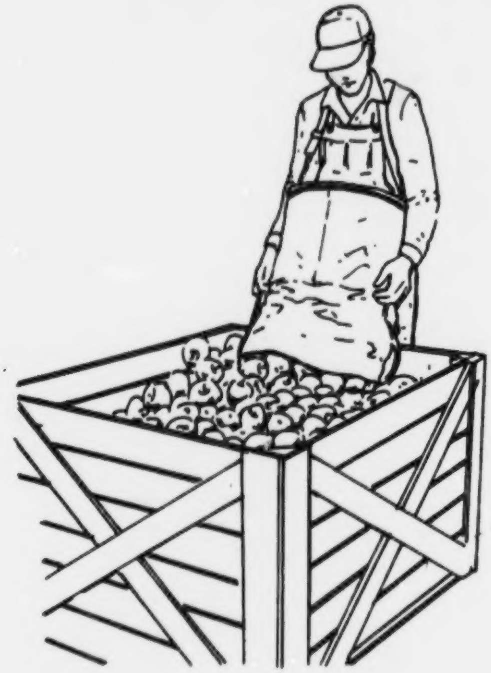
Tree fruits

- **Bulk bin** – Holds about 1,000 pounds of fruit; measures 28 1/4 inches high by 4 feet square. Additional machinery, such as forklift, needed.

- **Lug box** – Flat, wide crate that holds ½ to ¾ bushel, depending on the type of fruit.

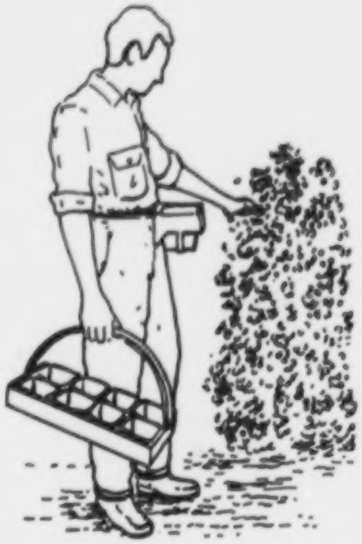
  NOTE: Lug boxes are being replaced by bulk bins, which are less expensive and last longer.

- **Picking buckets** – Metal or canvas-sided bucket with drop bottom; worn suspended from the shoulder and hangs in front and slightly to the side of the picker; holds about ½ bushel.



Small Fruits

- **Berry baskets** – Held around the waist by a canvas strap or belt; berries are then transferred to crates or baskets.



- **Pint and quart cartons or crates** – Used for small fruits such as strawberries and bramble fruits; often made of cardboard or plastic.

JOB SHEETS 1 & 2

Development of:
READING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely.
  - Have them read the instructions several times, noting the key words and ideas.
- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.
  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment.
  - Discuss what behaviors and attitudes constitute good work habits.
  - Make sure the student knows what is expected of him or her.

JOB SHEET 1

HARVEST FRUIT AND NUTS

IX

OBJECTIVE 8

Hand-pick an apple or pear.

INTRODUCTION

Many growers have turned to machinery to harvest their crops, but picking by hand is still the best way to harvest high-quality fruits. The fruit must be handled gently, otherwise bruises and skin punctures can attract disease-causing organisms. Remember how to determine the ripeness of the fruit (Objective 3), and then choose the apple or pear you want to pick.

MATERIALS AND EQUIPMENT

- Apple or pear trees with ripe fruit
- Picking containers

PROCEDURE

Functional Reading Skills
- Follow written instructions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

Yes No

1. Select an apple or pear that is at the proper stage for picking. ____ ____
2. Hold or cradle the fruit lightly in your hand. ____ ____
3. As you cup the fruit, gently pull upward and outward, so that the stem remains in the fruits and breaks free from the spur. ____ ____
4. Place the fruit gently in the packing bag or container; do NOT drop it in. ____ ____

   NOTE: Dropping the fruit into the container can cause bruises and punctures from the stem.

5. Empty the fruit from the container into a storage bin, keeping the fruit from bumping as little as possible. ____ ____
6. Have instructor check your work. ____ ____
7. Put away tools and equipment and clean up work area. ____ ____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ______________________________

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Fruit maturity	4	3	2	1
Pulled apple	4	3	2	1
Placement in container	4	3	2	1
Condition of fruit	4	3	2	1

EVALUATOR'S COMMENTS ______________________________

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training

3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required

2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill

1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 2 — HARVEST FRUIT AND NUTS — IX

OBJECTIVE 9

Hand-pick strawberries from the plant.

INTRODUCTION

Some varieties of strawberries need to be picked every day, while other varieties may need to be picked every two to three days. Most strawberry crops are picked by hand since mechanical methods of harvesting are still being developed. Berries are snapped from the stem and not pulled. Pulling will bruise the berry or break the skin, providing entry points for mold organisms. In some areas, berries are picked without stems for the freezing market.

MATERIALS AND EQUIPMENT

- Strawberry plants
- Picking containers

NOTE: These are most commonly plastic pint containers in cardboard boxes.

PROCEDURE

Functional Reading Skills

- Follow written instructions

Job Acquisition/Development Skills

- Master specific job task/procedure
- Practice good work habits/attitudes

	Yes	No
1. Select plant with ripe berries (See Objective 3).	_____	_____
2. Use thumbnail to snap stem about ½ inch from berry, leaving cap attached.	_____	_____
3. Place the berry gently into the picking container.	_____	_____
4. Have instructor check your work.	_____	_____
5. Put away equipment and clean up work area.	_____	_____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Berry ripeness	4	3	2	1
Stem and cap	4	3	2	1
Placement in container	4	3	2	1
Condition of berry	4	3	2	1

EVALUATOR'S COMMENTS

402A

AVERAGE RATING	**Evaluator note:** To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.
PERFORMANCE EVALUATION KEY	4 **Skilled** – Can perform job with no additional training 3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required 2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill 1 **Unskilled** – Is familiar with process, but is unable to perform job

403

Name ______________________ Score __________

OBJECTIVE 1

Match terms associated with harvesting fruit and nut crops to their correct definitions. Write the correct letter in the blank.

___ 1. Short, woody stem or branch that is the main fruiting area for most fruit trees

___ 2. Unit of weight equal to 2,000 pounds

___ 3. Stage of development in fruits or nuts when eating or processing quality is at its best

___ 4. Period when the first petals begin to fall

___ 5. Unit of dry measurement equal to 32 quarts

___ 6. Color of the flesh on the bottom of the fruit

___ 7. Disorder of a fruit that gives the area near the core a watery or glassy appearance

a. floor color

b. ton

c. pound

d. stem

e. spur

f. bushel

g. maturity

h. clear core

i. water core

j. ground color

k. full bloom

OBJECTIVE 2

Select from a list factors that help determine optimum harvest maturity. Place an "X" next to the correct answers.

___ 1. Flesh color

___ 2. Puncture test

___ 3. Bark color

___ 4. Leaf color

___ 5. Bloom color

___ 6. Ground color

____ 7. Number of days from planting

____ 8. Pressure test

____ 9. Number of days from full bloom

____10. Sugar content or sugar/acid ratio in grapes

OBJECTIVE 3

Complete sentences about determining when to harvest various fruit and nut crops. Write the correct words in the blanks.

1. Apples – A good indication that harvest time is near is when normal fruit begins to __________. The __________________ color of the fruit should turn from green to yellow-green. A taste test will also help indicate if the ________________________ are turning to sugar.

2. Peaches – The fruit is ripe when it separates easily from the _________________ on the tree. Pick them when the ground color changes from green to yellow. The skin of yellow-fleshed varieties gets an _____________________ tint; the skin of white-fleshed varieties turns from greenish to __________________________.

3. Pears – Pears are best when harvested in a slightly ______________________ stage. Look for color change – from green to yellow, change in flesh firmness, and change in soluble solids, all of which show a change in ______________ content. Another indication is when the __________________ separates easily from the tree. Size may also be a factor in picking because the shipper or buyer may require a certain size.

4. Plums – A _______________ is noted, depending on the variety. For example, blue or purple varieties change from green to greenish-blue or reddish-purple to dark blue or purple. As the color increases the flesh becomes slightly ______________, especially at the tip end.

5. Strawberries – Harvest when the berry is fully colored. ___________________ areas indicate it is not fully ripe. At least _____ percent of the berry surface must be red or pink in color to attain U.S. grade No. 1. First harvest occurs about ____ days after bloom. Berries should be kept out of the sun and refrigerated as soon as possible. Early morning picking is recommended because temperatures are cooler. Harvest on alternate days.

6. Blackberries – Pick when the fruit becomes soft and ____________________ and comes off easily in the hand. Berries that are black but hard to remove from the cluster may be ____________________. Berries should be picked in the early morning so as not to spoil as quickly. Harvest at least every ____________________ day.

7. Blueberries – A fully ripe berry will have ____________________ color and should come loose from the plant easily. A ____________________ ring around the "scar" or indentation where the fruit is attached to the stem, means the berry is not ripe. Harvest at ____________________ intervals.

8. Grapes – Ripeness is best determined by ________________ and ____________________. The natural bloom on the grape will become noticeable, and the berries will become slightly less __________________. The fruit should be handled as little as possible and care should be taken not to crush it.

9. Pecans – Ripen in mid-September through _______________. Crop can be harvested as _________________ begin to open.

OBJECTIVE 4 **Match various fruit and nut crops to their annual yield estimates.** Write the correct letter in the blanks.

___ 1. Apples
___ 2. Pecans
___ 3. Pears
___ 4. Peaches
___ 5. Plums
___ 6. Cherries (sour)
___ 7. Grapes
___ 8. Blueberries
___ 9. Blackberries
___ 10. Strawberries

a. 20 to 30 tons per acre
b. 1000 pounds per acre from mature tree
c. 200 to 400 bushels per acre
d. 1,000 to 5,000 quarts per acre
e. 8,000 to 11,000 pounds per acre
f. 9 to 10 tons per acre
g. Up to 1,200 pounds per acre
h. 6,000 to 8,000 pounds per acre
i. 3 to 5 tons per acre
j. 200 pounds per tree
k. Up to 1,000 bushels per acre
l. Up to 6 tons per acre
m. 2 bushels per tree
n. 300 to 600 bushels per acre (mature orchard)
o. 5,000 to 7,000 pounds per acre

OBJECTIVE 5 **Describe types of mechanical equipment used in harvesting.**

1. Shakers – ______________________________
2. Catching frames – ______________________________
3. Pickup machines (sweepers) – ______________________________
4. Mechanical aids – ______________________________
5. Forklift – ______________________________

OBJECTIVE 6 **List advantages and disadvantages of mechanical harvesting.** List two advantages and five disadvantages. Write your answers in the spaces below.

Advantages:

____

____

____

____

Disadvantages:

____

____

____

____

____

____

____

OBJECTIVE 7

Name types of containers used in harvesting tree fruits and small fruits. Name and describe three tree fruit containers and two small fruit containers. Write your answers in the spaces below.

Tree fruit

Small fruit

NOTICE: Objectives 8 and 9 are evaluated on job sheets in this unit. If you have not completed these components, see your instructor.

WRITTEN TEST ANSWERS

HARVEST FRUIT AND NUTS

IX

OBJECTIVE 1

1. e
2. b
3. g
4. k
5. f
6. j
7. i

OBJECTIVE 2

1, 4, 6, 8, 9, 10

OBJECTIVE 3

1. drop; ground; starches
2. twigs; orange, yellowish-white
3. green; sugar; stem
4. color change; soft
5. white; 75; 30
6. sweet; sour; third
7. uniform; reddish; weekly
8. color; flavor; firm
9. December; shucks

OBJECTIVE 4

1. n
2. b
3. a
4. c
5. i
6. g
7. l
8. o
9. h
10. e

OBJECTIVE 5

1. Shakers – Mechanical devices that attach to the limbs or trunks of trees to shake fruits or nuts loose.
2. Catching frames – Devices that catch and convey the fruits or nuts to bins.
3. Pickup machines (sweepers) – Collect fruits or nuts that have fallen to the ground.
4. Mechanical aids – Devices such as fixed position platform and movable tower attached to a boom; used to help workers collect fruit.
5. Forklift – Used to carry bins or boxes from field to packing house.

OBJECTIVE 6

Answers should include two of the following advantages and five of the following disadvantages.

Advantages:

- May be cost-effective when labor is scarce or expensive
- Machinery may pay for itself over an extended period of time, despite a large initial investment.

Disadvantages:

- Some types of fruits are picked more than once, depending on maturity; may be costly to move equipment through fields several times.
- Area of the orchard floor must be clear of obstacles such as tree props.
- High costs of machinery and upkeep may not make it profitable.
- Equipment or shaking and collecting processes may damage some fruits and nuts.
- Equipment may not collect all fruit on trees or plants.
- Equipment is somewhat non-selective in terms of fruit maturity, so grower may be left with some fruit that was picked too soon.

OBJECTIVE 7

Tree fruits

- Bulk bin – holds about 1,000 pounds of fruit; measures 28 1/4 inches high by 4 feet square. Additional machinery, such as forklift, needed.
- Lug box – Being replaced by bulk bin, which is less expensive and lasts longer.
- Picking buckets – Metal or canvas-sided bucket with drop bottom: worn suspended from the shoulder and hangs in front and slightly to the side of the picker; holds about ½ bushel.

Small fruits

- Berry baskets – Held around the waist by a canvas strap or belt; berries are then transferred to crate of baskets.
- Pint and quart cartons or crates – Used for small fruits such as strawberries and bramble fruits; often made of cardboard or plastic.

OBJECTIVE SHEET

PERFORM POST-HARVEST FUNCTIONS X

INTRODUCTION

By the time the crop is harvested, the grower has a great deal of time and money invested. Protecting the crop after harvest and preparing the product for shipment and sale are as important as planting, cultivating, and harvesting. Post harvest operations include all steps from harvest to retail sale for freshly consumed or minimally processed products, or from harvest to processing for heavily processed products. Along with the other steps, post-harvest functions provide an ample supply of fruits and nuts for today's consumer and insure an expanding market for growers.

UNIT OBJECTIVE

After completing this unit, the student will be familiar with terms associated with performing post-harvest functions and their definitions, will recognize broad categories of tools used in post-harvest functions, will understand the functions of packaging materials, will know common methods of storage and steps taken to prevent spoilage, and will be able to list alternative markets for harvested products. The student will demonstrate these competencies by completing the job sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit the student will be able to:

1. Match terms associated with performing post-harvest functions to their correct definitions.
2. List the criteria of quality for harvested products.
3. Distinguish among machines used to move the product, to grade or sort the product, and to prepare the product for packaging.
4. Complete statements about packaging materials.
5. Select words or phrases to complete statements about storing fruits and nuts.
6. Discuss guidelines for handling harvested crops to avoid spoilage.
7. List alternative markets for lower quality fruits and nuts.
8. Use tools and equipment by washing, drying, and cracking a supply of pecans. (Job Sheet 1)
9. Evaluate the effects of different storage environments. (Job Sheet 2)

SUGGESTED ACTIVITIES

PERFORM POST-HARVEST FUNCTIONS X

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.
- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.
- Review teaching suggestions and plan classroom activities.
- Determine how you will schedule time for students to demonstrate competence in the required procedures.
- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

- Collect a variety of packaging and shipping containers.
- Arrange for fruit and vegetable samples to be available to students.
- Arrange for field trips to crop sites, preferably during harvest.
- Plan field trips to area packaging, storage, or processing facilities.
- Arrange for use of all equipment and supplies needed to complete job sheets.
- Arrange for use of mechanized or manual nut cracker(s).

DELIVERY

Objective 1: Match terms associated with performing post-harvest functions to their correct definitions.

- Discuss terms.

- As this unit includes few new terms, be sure to note any terms introduced by guest speakers and incorporate them in later lessons.

Objective 2: List the criteria of quality for harvested products.

- Invite a supermarket fresh-produce manager or food scientist to discuss quality in fruits and nuts.

- List a variety of fruits and nuts and discuss what criteria are used to judge them.

- Bring a variety of apples to class. Have students determine quality from the standpoint of a consumer, a shipper, a grower, and a juice maker. Do the same with other fruits.

Objective 3: Distinguish among machines used to move the product, to grade or sort the product, and to prepare the product for packaging.

- Tools are listed in broad, general categories. The actual piece of equipment varies according to the crop, the size of the operation, and the needs of the grower. Help students realize this by supplying photos and information about several versions of various tools.

- Have students list or bring simple examples of these tools, such as wicker baskets for dumping aids, household vegetable brushes for brushes, or nut crackers for huskers and shellers.

- Have students practice and complete Job Sheet 1, cracking and shelling pecans. Identify all tools used, including bowls, waste cans, plastic bags, and crackers.

Objective 4: Complete statements about packaging materials.

- Have students collect various packaging materials they find at home and at the grocery store.

- Have students rate the samples they bring for various qualities such as strength, weight, ability to withstand high humidity levels, reusability, recyclability, and attractiveness.

- Have students design protective packaging for various fruits and nuts.

- Have students ask their parents about packaging materials they no longer see, such as wooden quart baskets for strawberries or nylon netting for grapes.

- Invite a local grocer to discuss the packaging his or her store receives and uses.

- For more detailed information on packaging and labeling, see Unit IX "Packaging Agricultural Products" in *Agricultural Products and Processing*, CIMC, 1990.

Objective 5: Select words or phrases to complete statements about storing fruits and nuts.

- Invite a chemist to discuss ethylene gas and respiration.

- Store several examples of different fruits and nuts by various methods listed. Have students track their spoilage and draw conclusions.

- Have students chill fruits by exposing them to cold air and cold water. Compare the two methods and draw conclusions.

- Invite a local nut grower to discuss storage. Be sure he or she brings examples of common local nuts.

- Have students complete Job Sheet 2. Tour the cooling facility.

Objective 6: Discuss guidelines for handling harvested crops to avoid spoilage.

- Invite a local fruit expert or county extension agent to discuss various spoilage and provide examples.

Objective 7: List alternative markets for lower quality fruits and nuts.

- Have students list alternative uses for fruits and nuts. This should be an on-going project, as they will be surprised at how many they discover.

APPLICATION

Objective 8: Use tools and equipment by washing, drying, and cracking a supply of pecans.

- If possible, use several different methods of washing, drying, and cracking nuts. If the class is mechanically inclined, have students construct a cracker. If it is competitive, hold a competition.

- Use the shells to fuel a fire.

Objective 9: Evaluate the effects of different storage environments.

- Do not substitute a refrigerator or freezer for the cooler room. If a cooler is unavailable, invite a fruit grower to discuss its use.
- Chilling injury in bananas might be an easy lesson for this job sheet. Browning or blackening of the peel is easy to see and should show up in a refrigerated sample quickly, especially when placed at room temperature.
- Have students complete Job Sheets 1 and 2.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.

- Give the written test.
- Complete appropriate sections of competency profiles.

- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Kader, Adel A., ed. *Postharvest Technology of Horticultural Crops*, 2nd ed. Publication 3311, Division of Agriculture and Natural Resources, University of California, 6701 San Pablo Avenue, Oakland, CA.
- Produce Marketing Association (PMA), P.O. 6036, Newark, DE, 19714.
- United Fresh Fruit and Vegetable Association (UFFVA), 722 North Washington, Alexandria, VA 22314.

UNIT REFERENCES

- Debney, H. G., K. J. Blacker, B. J. Redding, and J.B. Watkins. *Handling and Storage Practices for Fresh Fruits and Vegetables -- Product Manual.* United Fresh Fruits & Vegetables Association: Brisbane, Australia, 1980.
- Eskin, N. A. M., ed. *Quality and Preservation of Vegetables.* CRC Press: Boca Raton, FL, 1989.
- Kader, Adel A., ed. *Postharvest Technology of Horticultural Crops*, 2nd ed. Publication 3311, Division of Agriculture and Natural Resources, University of California, 6701 San Pablo Avenue, Oakland, CA 1992.
- O'Brien, M., B. F. Cargill, and R. B. Fridley. *Principles and Practices for Harvesting and Handling of Fruits and Nuts.* AVI Publishing Co.: Westport, CT, 1983.
- Peleg, K. *Produce Handling, Packaging and Distribution.*, AVI Publishing: Westport, CT, 1985.
- Ryall, A. L., and W. T. Pentzer. *Handling, Transportation and Storage of Fruits and Vegetables,* Vol. 2, *Fruits and Tree Nuts.* AVI Publishing Co.: Westport, CT, 1982.
- Salunkhe, D. K., H. R. Bolin, and N. R. Reddy. *Storage, Processing, and Nutritional Quality of Fruits and Vegetables*, 2nd ed., Vol. I. CRC Press: Boca Raton, FL, 1990.
- Salunkhe, D. K., H. R. Bolin, And N. R. Reddy. Storage, *Processing, and Nutritional Quality of Fruits and Vegetables*, 2nd ed., Vol. II. CRC Press: Boca Raton, FL, 1990.

- Wills, R. H. H., W. B. McGlasson, D. Graham, T. H. Lee, and E. G. Hall. *Postharvest: An Introduction to the Physiology and Handling of Fruit and Vegetables.* Van Nostrand Reinhold: New York, NY, 1989.

INFORMATION SHEET

PERFORM POST-HARVEST FUNCTIONS X

OBJECTIVE 1

Match terms associated with performing post-harvest functions to their correct definitions.

- **by-product** – the portion of the fruit or nut which is not edible but can be used for other purposes
- **grading** – assigning a rating to a fruit or nut according to its individual characteristics and quality
- **heavy or extensive processing** – subjecting the products to chemical or temperature changes which prepare them for long-term storage

  EXAMPLES: Canning, drying, freezing
- **light or minimal processing** – methods of rendering fresh food products suitable for marketing without making them shelf stable

  EXAMPLES: Shelled peas or pecans, pre-shredded lettuce or cabbage, prepeeled fruits
- **sorting** – separating fruits or nuts according to size or color

OBJECTIVE 2

List the criteria of quality for harvested products.

The quality of the product will mean different things to different people. At the time of harvest, for example, a good pear is one that will give the grower the greatest return, depending upon the market and the distance the fruit will be shipped. To the shipper, a quality pear is a very hard pear that will not be damaged during transport. To a canner, the pear must be firm, but ripe. The consumer desires a soft, tasty pear.

- **Appearance** – The product should be the right size, shape, and color and be free of bruises, molds, and disease.
- **Freshness** – The product should smell and appear fresh, be free of shriveling or dried leaves, and not be overly soft.
- **Flavor** – The expected sweetness, texture, and fragrance should be found in the product.
- **Nutritional value** – This is a growing concern, changing some farming methods.

- **Safety** – The product should be safe for consumption. This is a growing concern for both fresh and processed products.

OBJECTIVE 3

Distinguish among machines used to move the product, to grade or sort the product, and to prepare the product for packaging.

Machines are chosen according to the volume of product they will be expected to handle, the size of the operation, and the machine's ability to handle the product without harming it.

Machines for moving the product

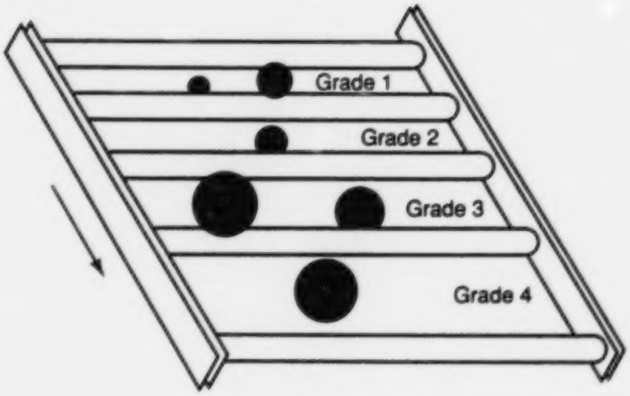
- **Dumping aids** – Load the product into machinery while protecting it from bruising
- **Feed belts** – Move the product to machinery and from one machine or area to another
- **Packing belts and bins** – Move sized and graded products to packaging areas

Machines for sorting and grading

- **Eliminators** – Remove substandard products; usually the first procedure used on harvested products
- **Sorting rolls** – Rotate the product to facilitate visual grading

  NOTE: Some electronic equipment can grade by color intensity, making visual grading unnecessary.

- **Sizing units** – Separate products by size, usually by passing the product over or through a sized opening, but occasionally by counterweight



Machines used for preparing the product for packaging

- **Brushes and washers** – Clean the products

  NOTE: Most buyers require cleaned products.

- **Waxers** – Put a thin coat of wax on some products to extend shelf life
- **Huskers and shellers** – Remove the husks and shells from nuts; equipment can be elaborate machinery or simple devices such as tires or corn shuckers
- **Bagging machinery and automatic packing equipment** – Weigh, sack, wrap, and pack the product

OBJECTIVE 4

Complete statements about packaging materials.

Few growers still hand-pack fruits. Studies have shown that mechanized packing is as safe for the product and is less expensive.

The following must be met:

- Packaging must be easily **stacked** and stored.
- The **product** must be identified.
- Packaging must not **contaminate** the product.
- Packaging must result in **cost efficient** transporting and storage.
- Packaging must be strong enough to **transport** the product while protecting it from injury.

  NOTE: Some new packaging materials, such as polyethylene wraps, not only protect the product, but actually help preserve it.

- Packaging must be able to withstand storage **moisture** and **temperature** levels.
- Packaging must allow **attractive** display of the product.
- Packaging must be lightweight and **affordable**.

OBJECTIVE 5

Select words or phrases to complete statements about storing fruits and nuts.

Fruits and nuts are alive and continue to "breathe" after harvesting. Because they are breathing, they produce heat when stored and affect the chemical composition of the air. Most storage methods for fresh fruits and nuts attempt to slow the respiration by adjusting the environment.

Methods of storage

- **Refrigeration** – Storing fruits and nuts at approximately 32° F will slow respiration and ripening. To illustrate its effectiveness, consider that: apples spoil twice as fast at 70° F as at 50°; twice as fast at 50° as at 40°; and twice as fast at 40° as at 32°. Refrigeration is the most common storage method for fruits and nuts, so most operations require access to a cooling room.
- **Waxing** – A thin layer of wax is used on fruits with porous skins, such as oranges, to hold in moisture.
- **Packaging** – Some packaging, such as polyethylene bags and liners, will extend shelf life. As the fruit breathes, a high carbon dioxide/low oxygen level is produced. Polyethylene traps this atmosphere and slows the breathing, which, in turn, slows ripening.
- **Special atmosphere** – Ripening of stored fruits can be controlled by manipulating the oxygen and carbon dioxide levels in the storage chamber. Additionally, chemicals naturally produced during ripening, such as ethylene gas, can be added to the storage chamber to encourage even ripening.

  NOTE: Although ethylene gas may be safely used to ripen fruit, in many cases it is removed from storage facilities. Ethylene in exhaust fumes or other sources may cause over-ripening. If two or more crops are stored together, the ethylene gas produced by one product may cause spoilage in another.
- **Humidity control and drying** – Fruits contain a lot of fluid. If the atmosphere is not moist enough, the moisture in the fruit will evaporate, and the fruit will shrivel. To prevent this, most fruits are stored at 90 - 95% humidity levels.

  Nuts, however, must be stored in low-humidity. Like fruit, they will produce heat during storage. The heat will discolor the nut meat and lead to spoilage. To prevent this, nuts are air dried, then stored at humidity levels between 5 - 10%.

- **Canning and other processes** – Canning has become a large portion of the fruit market and many crops, such as the Bartlett pear, are now raised specifically for canning. Before products are canned, they are usually mixed with a syrup and may be cooked. When canned, they are vacuum-packed and heat-sterilized in glass or metal containers.

  Nuts are usually dried and roasted before being bagged.

  Fruits and nuts may also be used for pre-cooked products, such as pies. Fruits may be frozen or used for juice, particularly if they are sub-standard.

OBJECTIVE 6 **Discuss guidelines for handling harvested crops to avoid spoilage.**

- **Handle gently** – Damage to fruit can lead to fruit spoilage, which can spread. Preventing bruising will not only help prevent spoilage, but will also insure a more salable product.
- **Inspect often** – Some fruits spoil from the inside. Spoilage, especially in nuts, may be difficult to detect. Inspection should be thorough, repeated often, and may include steps to make spoilage more apparent. For example, nut shells may be washed in a solution containing bleach. This procedure makes it easier to see some dark spoilage signs.
- **Check pulp temperature** – As noted before, fruit and nuts continue to breathe after harvesting, and this respiration raises their temperature. Products should be cooled promptly, and the temperature of the fruit and storage area should be monitored.
- **Store in an appropriate environment** – Temperature, humidity, atmospheric composition, and packaging all affect the rate of spoilage. Applications of fungicides or other chemical treatments may be used to extend shelf life.
- **Ship as soon as possible** – Even under the best of conditions, storage time is limited. Some crops, such as walnuts or apples have relatively long, safe storage periods; others, such as grapes and strawberries, will spoil quickly after harvesting, even under ideal conditions.

OBJECTIVE 7 **List alternative markets for lower quality fruits and nuts.**

Processors demand a product which meets their needs. A "quality" product for the processor may not be suitable for fresh consumption, but must meet the processor's definition of quality. This might mean growing a variety of apples for cooking that are too tough to sell raw, cut can withstand mechanical harvesting to meet volume requirements.

- **Fruits**

  NOTE: Many of these products rely on a blend of varieties to keep a standard taste. Canned foods do not come from waste, but are usually high-quality fruit.

  - Sauces

    EXAMPLE: Applesauce

  - Juices
  - Cider
  - Concentrated and frozen juices
  - Pies and other pre-cooked foods
  - Apple butter, jams, jellies

- **Nuts**

  NOTE: Small or otherwise substandard nuts still contain usable meat.

  - Butters (peanut, almond, or cashew butter)
  - Ice cream
  - Cookies, cakes, and other baked goods
  - Flavorings
  - Oils
  - Shells and inedible by-products are often used as fuel for factory furnaces and may also be used in paint or animal feeds.

JOB SHEET 1

Development of:
READING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty following written instructions:
  - Discuss the possible consequences of not following instructions precisely.
  - Have them read the instructions several times, noting the key words and ideas.
- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.
  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment.
  - Discuss what behaviors and attitudes constitute good work habits.
  - Make sure the student knows what is expected of him or her.

JOB SHEET 2

Development of:
READING SKILLS
WRITING SKILLS
SCIENCE SKILLS
CREATIVE THINKING/PROBLEM SOLVING
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, writing, science, creative thinking/problem solving and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Following written instructions

  WRITING

  - Using standard grammar, spelling, and capitalization
  - Stating ideas clearly
  - Using complete sentences
  - Composing reports

  SCIENCE

  - Conducting experiments

CREATIVE THINKING/PROBLEM SOLVING

- Drawing conclusions

EMPLOYABILITY

- Mastering a specific job task/procedure
- Practicing good work habits/attitudes

- If students have difficulty using standard grammar, spelling, and capitalization.:
  - Review basic grammar skills.
  - Review rules for using capitals.
  - Encourage them to use a dictionary to check the spelling of any words of which they are uncertain.
  - Discuss the importance of being able to communicate by the written word.
- If students have difficulty stating ideas clearly:
  - Suggest they have their thoughts organized before they begin writing.
  - Review the information noting the key words and ideas.
  - Discuss the importance of stating the ideas clearly.
  - Instruct them to use simple concise words.
- If students have difficulty using complete sentences, remind them to check for a subject and a verb (that is singular or plural to agree with the subject), and a predicate that follows the verb, if it is needed to complete the idea.
- If students have difficulty composing reports:
  - Instruct them to determine the purpose of the report.
  - Instruct them to write down their preliminary ideas.
  - Suggest they organize their ideas.
  - Instruct them to write a first draft and to carefully proofread and evaluate it in order to make corrections and revisions before making the final copy.

  - Offer them examples of short reports to use as models.

- If students have difficulty drawing conclusions:
  - Direct them to examine the collected data and look for patterns.
  - Suggest they think through their prior knowledge and understanding of cooling and climatic factors to reach a conclusion.
  - Suggest they consider all the factors listed and determine why some factors were affected more than others.
  - Invite discussion about other food products and how they would react under the same conditions.
- For additional suggestions on teaching basic skills, refer to suggestions for Job Sheet 1.

JOB SHEET 1

PERFORM POST-HARVEST FUNCTIONS

X

OBJECTIVE 8

Use tools and equipment by washing, drying, and cracking a supply of pecans.

TOOLS AND MATERIALS

- Pecans
- Warm water
- Pecan crackers
- Electronic nippers (similar to pliers)
- Picks
- Containers for meats and waste

If a large or automated cracker is available, use the operating procedures provided with the cracker or the owner's instructions.

PROCEDURE

	Yes	No
1. Remove hulls, if any are still in place.	____	____
2. Sort the nuts. Remove any that appear to have mold or insect holes.	____	____
3. Wash the pecans in warm water and dry in the sun for 1-2 days.	____	____
4. Crack the pecans from end-to-end, from side-to-side at the widest point, or from side-to-side at the narrowest point.	____	____
• **Pressure-type cracker** – Load the nut so it is cracked from end-to-end.	____	____
• **Hand cracker or hammer** – Crack it from side-to-side at the widest point.	____	____
5. Remove the meat using the nippers. As much as possible, pull the meats gently from the shell rather than using the picks.	____	____

NOTE: The nippers can also be used to pull the shell from the meat.

	Yes	No
6. Put the meats in one container, the shells in another.	____	____

Functional Reading Skills

- Follow written instructions

Job Acquisition/ Development Skills

- Master specific job task/procedure
- Locate appropriate jobs

	Yes	No
7. Have your instructor check your work.	____	____
8. Put away tools and materials and clean the work area.	____	____

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS ____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Practiced safety rules	4	3	2	1
Removed full nut meats	4	3	2	1
Removed all meat from the shell	4	3	2	1
Sorted meats from shell	4	3	2	1
Followed instructions	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training

3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required

2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill

1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 2 — PERFORM POST-HARVEST FUNCTIONS — X

OBJECTIVE 9 — **Evaluate the effects of different storage environments.**

TOOLS AND MATERIALS

- Six apples
- Three plastic bags
- Three labels
- Notebook and pencil

PROCEDURE

1. Place two apples in each bag. ____ ____
2. Seal each bag and label it with the date. ____ ____
3. Label the first bag "no cooling" and place it on a counter top. ____ ____
4. Label the second bag "home refrigerator" and place it in a refrigerator. ____ ____
5. Label the third bag "cooler room" and place it in a cooler room. ____ ____
6. In two weeks, collect all three bags and compare the apples. Check color, taste, ripeness, and fragrance. ____ ____
7. List your findings in the notebook. ____ ____
8. Based on your findings, write a brief report on your conclusions about the effects of cooling and the climate control found in home refrigerators and in cooling rooms. ____ ____
9. Have your instructor check your work. ____ ____
10. Put away tools and materials and clean the work area. ____ ____

Functional Reading Skills
- Follow written instructionS

Language Skills
- Use standard grammar, spelling, and capitalization
- State ideas clearly

Composition Skills
- Use complete sentences
- Compose reports

General Math Skills
- Conduct experiments

Cognitive Activities Skills
- Draw conclusions

Job Acquisition/ Development Skills
- Master specific job task/procedure
- Practice good work habits/attitudes

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:

Packaged and stored apples as directed	4	3	2	1
Correctly evaluated aged apples on all relevant criteria	4	3	2	1
Organized notes logically	4	3	2	1
Wrote brief report of conclusions	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** — Can perform job with no additional training
3 **Moderately Skilled** — Has performed job during training program; limited additional training may be required
2 **Limited Skill** — Has performed job during training program; additional training is required to develop skill
1 **Unskilled** — Is familiar with process, but is unable to perform job

WRITTEN TEST

PERFORM POST-HARVEST FUNCTIONS X

OBJECTIVE 1

Match terms associated with performing post-harvest functions to their correct definitions. Write the correct letter in the blank.

_____ 1. The portion of the fruit or nut which is not edible but can be used for other purposes

_____ 2. Methods of rendering fresh food products suitable for marketing without making them shelf stable

_____ 3. Assigning a rating to a fruit or nut according to its individual characteristics and quality

_____ 4. Subjecting the products to chemical or temperature changes which prepare them for long-term storage

_____ 5. Separating fruits or nuts according to size or color

a. sorting
b. separating
c. grading
d. by-product
e. waste
f. heavy or extensive processing
g. preserving
h. light or minimal processing

OBJECTIVE 2

List the criteria of quality for harvested products. Write the criteria in the spaces below.

____

____

____

____

____

____

May be photocopied for student use.

OBJECTIVE 3 **Distinguish among machines used to move the product, to grade or sort the product, and to prepare the product for packaging.** Write "M" for machines used to move products, "S/G" for machines used to sort or grade products, and "P" for machines used to prepare the product for packaging.

_____ 1. Bagging machinery and automatic packing equipment

_____ 2. Brushes and waxers

_____ 3. Dumping aids

_____ 4. Eliminators

_____ 5. Feed belts

_____ 6. Huskers and shellers

_____ 7. Packing belts and bins

_____ 8. Sizing units

_____ 9. Sorting rolls

_____ 10. Waxers

OBJECTIVE 4 **Complete statements about packaging materials.** Write the correct word or words in the blank.

1. Packaging must not ___________________________ the product.
2. Packaging must be strong enough to ____________________ the product while protecting it from injury.
3. The ______________________________ must be identified.
4. Packaging must be able to withstand storage ___________ and ____ levels.
5. Packaging must be lightweight and ______________________.
6. Packaging must be easily __________________ and stored.
7. Packaging must result in ______________________________ transporting and storage.
8. Packaging must allow ______________ display of the product.

OBJECTIVE 5

Select words or phrases to complete statements about storing fruits and nuts. Write the correct letter in the blanks.

_____ 1. To hold in moisture, fruits with porous skins are coated with a thin layer of _____.

a. wax
b. polish
c. sealer
d. antioxidizer

_____ 2. Ripening of stored fruits in a cooling room can be controlled by manipulating the levels of _____.

a. moisture and oxygen
b. carbon dioxide, oxygen, and ethylene gas
c. carbon dioxide, moisture, and ethylene gas
d. ethylene gas, moisture, and oxygen

_____ 3. Crops such as the Bartlett pear are _____.

a. rarely grown
b. raised specifically for canning
c. good all-around fruits
d. cultivated for freezability

_____ 4. Storing fruits at approximately 32° F will slow _____.

a. respiration and growth of mold
b. wilting and respiration
c. respiration and ripening
d. coloration and ripening

_____ 5. Some packaging, such as polyethylene bags and liners, will _____.

a. extend shelf life
b. lower the product's temperature
c. keep the product warm
d. prevent carbon dioxide buildup

_____ 6. During ripening, fruits produce _____.

a. polyethylene
b. nitrogen
c. ethylene gas
d. bacteria

May be photocopied for student use.

_____ 7. The best humidity level for storing fruits is _____.

a. 5-10%
b. 10-50%
c. 50-90%
d. 90-95%

_____ 8. The best humidity level for storing nuts is _____.

a. 5-10%
b. 10-50%
c. 50-90%
d. 90-95%

OBJECTIVE 6 **Discuss guidelines for handling harvested crops to avoid spoilage.**

1. What are the benefits of handling the product gently to prevent bruising?

____

____

2. What are the guidelines for inspecting harvested crops?

____

____

3. What procedure will make dark spots more visible on nut shells?

____

4. Why should pulp temperature be monitored?

____

____

5. What four factors that affect the rate of spoilage can be controlled by storing the product in an appropriate environment?

____

____

____

____

May be photocopied for student use.

6. What is the guideline for shipping fruits such as strawberries and grapes?

____

OBJECTIVE 7 **List alternative markets for lower quality fruits and nuts.** List three uses for fruits and three uses for nuts and shells.

Fruits

____

____

____

Nuts and shells

____

____

____

NOTICE: Objectives 8 and 9 are evaluated on Job Sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

PERFORM POST-HARVEST FUNCTIONS X

OBJECTIVE 1

1. d
2. h
3. c
4. f
5. a

OBJECTIVE 2

Appearance, freshness, flavor, nutritional value, safety

OBJECTIVE 3

1. P
2. P
3. M
4. S/G
5. M
6. P
7. M
8. S/G
9. S/G
10. P

OBJECTIVE 4

1. contaminate
2. transport
3. product
4. moisture, temperature
5. affordable
6. stacked
7. cost efficient
8. attractive

OBJECTIVE 5

1. a
2. b
3. b
4. c
5. a
6. c
7. d
8. a

OBJECTIVE 6

1. Prevent spoilage and insure a more salable product
2. Inspection should be thorough, repeated often, and may include steps to make spoilage more apparent.
3. Washing nut shells in a solution containing bleach
4. Because respiration after harvesting raises their temperature
5. Temperature, humidity, atmospheric composition, packaging
6. Ship as soon as possible

OBJECTIVE 7

Answer should include three from each category:

Fruits:
Sauces
Juices
Cider
Concentrated/frozen juices
Pies and other baked goods
Apple butter, jams, and jellies
Other items discussed in class

Nuts and shells:
Butters
Ice creams
Cookies, cakes, and other baked goods
Flavorings
Oils
Fuel
Paint
Animal feeds

OBJECTIVE SHEET

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE

XI

INTRODUCTION

The work of the grower goes far beyond working in the field. Crops may be planted, grown, harvested, and stored, yet the work of the grower is not complete. Today, agriculture and business are not separate sciences, but are two facets of growing foods.

UNIT OBJECTIVE

After completing this unit the student will be able to recognize terms associated with inventory, shipping, maintenance procedures, and records; understand shipping standards and regulations; discuss records needed and their importance; and understand inventory procedures and basic storage and transportation practices. The student will demonstrate these competencies by completing assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with taking inventory, shipping, and maintaining merchandise to their correct definitions.
2. Select from a list true statements about federal and state shipping standards and regulations.
3. Discuss why good record keeping is important.
4. Match records to their descriptions.
5. Complete statements about maintaining inventory.
6. Choose words or phrases that complete statements about storing plants and materials.
7. Prepare inventory and shipping forms. (Assignment Sheet 1)
8. Write a loading order for a delivery truck route. (Assignment Sheet 2)

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with taking inventory, shipping, and maintaining merchandise to their correct definitions.

- Discuss the terms.

- Be sure students understand the multiple definitions of documents and inventory.

- Point out that these terms are used in all businesses.

Objective 2: Select from a list true statements about federal and state shipping standards and regulations.

- Invite a shipper or government inspector to discuss shipping regulations.

- Have students discuss what might cause regulations to differ from state to state.

- Have students discuss current trends or events which might affect regulations. Include views toward organic gardening, the lack of sufficient waste disposal facilities, and migrating insects entering the United States.

Objective 3: Discuss why good record keeping is important.

- Invite a banker or credit officer to discuss the need for credit and record-keeping.

- Invite a county extension agent or FHA representative to discuss farm financing programs and records related to agriculture.

Objective 4: Match records to their descriptions.

Objective 5: Complete statements about maintaining inventory.

- Invite an accountant to explain the different types of records and ledgers.

- Have students bring examples of different records and determine which category they are from.

- Illustrate the simple forms of these records by examining a seed packet and comparing it to the description of scheduling plans and records. Have students suggest other common examples of these records.

- Introduce students to tickler files, calendars, and other records related to this list which might be of use to them.

- Have students set up files for their own affairs.

- Have students form mock companies and set up proper books.

Objective 6: Choose words or phrases that complete statements about storing plants and materials.

- Review common facts in Unit X, *Perform Post-Harvest Functions.*

- Have students view storage, shipping, and receiving facilities.

APPLICATION

Objective 7: Prepare inventory and shipping forms. (Assignment Sheet 1)

- Have students complete Assignment Sheet 1.

- Provide similar forms with different formats and have students transfer the information.

- Provide students with computer-formatted forms and allow them to enter the information. If it is impossible for them to actually enter the information, at least allow them to view the computer-forms being used by businesses. Invite a representative to discuss how the information works and how the change to computer records has affected the business.

Objective 8: Write a loading order for a delivery truck route. (Assignment Sheet 2)

- Have students complete Assignment Sheet 2.

- Explain the process of reverse order loading and that it not only saves time but also helps ensure that customers receive the orders they requested.

EVALUATION

Pretest

- Give written test as pretest.

- Determine individual study requirements from pretest results.

- Counsel students individually on pretest results and study requirements.

- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.

- Complete appropriate section of competency profiles.

- Reteach and reevaluate if necessary.

- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

- Give the written test.

  NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.

- Reteach and retest if necessary.

- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Print Media

- Kader, A. A., et al. *Postharvest Technology of Horticultural Crops.* University of California, Division of Agriculture and Natural Resources, Publication 331: Oakland, CA, 1992.

UNIT REFERENCES

- *Shipping and Receiving.* Oklahoma Department of Vocational and Technical Education, Stillwater, OK, 1989.

- *Horticulture Occupations.* Texas A & M Vocational Instructional Services, 1986.

- O'Brien, Michael, et al. *Principles and Practices for Harvesting and Handling Fruits and Nuts.* AVI Publishing Company, Inc.: Westport, CT, 1983.

- Kader, A. A., et al. *Postharvest Technology of Horticultural Crops.* University of California, Division of Agriculture and Natural Resources, Publication 331: Oakland, CA, 1992.

INFORMATION SHEET

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE *XI*

OBJECTIVE 1

Match terms associated with taking inventory, shipping, and maintaining merchandise to their correct definitions.

- **assets** – anything owned that has value

  EXAMPLES: land, produce in storage

- **compensation** – payment for work done

  NOTE: Compensation can be money or benefits such as insurance, profit sharing, or time off.

- **credit** – money made available by a bank or lender
- **documents** – 1) written records of actions or exchanges; 2) the paper the records are kept on
- **inventory** – 1) the stock on hand; 2) an accounting of the stock on hand; 3) the act of counting the stock on hand
- **labor** – group of people employed by the operation
- **liabilities** – debts owed

OBJECTIVE 2

Select from a list true statements about federal and state shipping standards and regulations.

- Transportation regulations protect consumers by insuring safe handling and storage practices. These regulations may cover the personnel, buildings and facilities, equipment, production and processes, and quality of food used or shipped.
- Transportation regulations also protect the grower by prohibiting infestation. Pests such as the Mediterranean Fruit Fly can be stopped by inspection and quarantine at the state level or at the federal level if warranted.
- Transportation regulations limit the mode of transportation. Trucks licensed for transporting food cannot also transport petroleum, for example.

- Regulations may be tailored to meet the needs of the individual state agricultural community. States may institute regulations protecting crops grown there. On the other hand, disease or infestation affecting one state or region may result in strict federal regulations allowing few, if any, shipments of the product out of that area.

OBJECTIVE 3

Discuss why good record keeping is important.

Like any other business owner, the fruit and nut grower's goal is to make money. To operate efficiently, maintain adequate inventory, receive credit, and meet legal requirements, proper records must be kept.

- **Financial status records** will reflect current assets and liabilities. These records may cover totals for the past year or month, or may show a running total to date. They must be used to determine taxes and apply for loans or other credit. Additionally, these records allow the grower to know his financial standing.

- **Inventory records** will reflect the demand for products, the time required for processing and shipment, and the products on hand. These records help the grower know if requested shipments can be made and determine what products are in high demand so the grower can make better plans for upcoming crops.

- **Labor records** are usually required by law. These records will show hours worked, taxes withheld, and salaries. Additionally, records of hours worked and performance evaluations help the grower supervise workers.

- **Shipping records** document when and by what method shipments are made or received. These records help the grower maintain an accurate inventory count and trace lost deliveries. Conditions during transportation (temperature, etc...) may also be logged to document maintenance of proper shipping conditions.

- **Administrative records** will enable the grower to see that equipment is properly maintained, chemicals used are safe and documented, and government regulations are followed.

OBJECTIVE 4

Match records to their descriptions.

Financial Records

- **balance sheet** – shows the net worth of a business at the end of the year by subtracting assets from liabilities
- **income statement** – summarizes information about expenses and income over a given period of time
- **annual business budget** – a written plan to compare alternative courses of action
- **cash flow summary** – a record of monthly cash income and expenses
- **net worth statement** – lists the operation's assets and liabilities to determine its value
- **sales records** – documents each financial transaction

Inventory Records

- **inventory status records** – list what should be on hand; checked by actually counting product
- **product structure records** – list what goes into a product, how it is assembled, and where the raw materials are obtained. For example, it may list how peaches are to be treated, at what temperature and humidity level they are to be stored, how they are to be packaged, and where chemicals and packaging may be purchased.
- **scheduling plans and records** – set timetable for planting, harvesting, treating, storage, and shipment

Shipping Records

- **bill of lading** – accompanies the shipment and is used by the shipper to specify how many containers are shipped, where they are to be delivered, etc.
- **invoice** – billing for shipment
- **shipping requisition** – records that an order has been placed, what was ordered, method of payment, etc.

Labor Records

- **tax forms** – W2, W4 forms and appropriate tax withholdings and payments for employee income taxes

- **evaluation/employment history** – lists date of hire, record of performance, etc.
- **time records** – records hours worked, sick leave and vacation time due and taken
- **compensation (salary and benefits)** – may include simple wages or salary, or may include profit sharing, insurance, or other benefit information

Administrative Records

- **cost records** – measure efficiency (what was accomplished for each dollar spent) and effectiveness (what goals were reached)
- **equipment records** – money spent to insure that tools, trucks, washing and sorting equipment, and other machinery are maintained. Records document licensing, insurance, maintenance, and mileage or hours of use. Records of fuel consumption can be used to determine efficiency and operating costs.
- **chemical or spraying records** – report the use of preservatives, herbicides, pesticides, and other chemical applications, especially "Restricted Use" chemicals. They indicate the type of chemical used and the amount, method, and time of application. Chemical records are important for proving that safe chemicals are used, and used correctly, and that government restrictions are followed.
- **compliance records** – they can show that government regulations are followed; include applications, compliance forms, and other types of reports for government support such as farm subsidy and conversation programs.
- **spoilage records** – record of losses; may be used to pinpoint problems in transportation or storage
- **transportation records** – records product transportation and cost, including inspection.

OBJECTIVE 5 **Complete statements about maintaining inventory.**

- Maintaining inventory is much like maintaining a checking account. Care should be taken to see that all records match, that the amount of material shipped is actually what the invoice and packing sheet state, and that the product is secure.

- The bill of lading is similar to a deposit slip. It proves something has been received and put into storage. The invoice serves the same purpose as the bank's record of the deposit transaction – it says the transaction was received and credited.

- The shipping requisition, on the other hand, documents that something has been removed from storage, much as a cancelled check shows that money has been removed from a bank account.

- The final inventory is similar to the bank statement and will show all transactions. Like a bank statement, regular checks are necessary.

OBJECTIVE 6

Choose words or phrases that complete statements about storing plants and material.

- Rapid turnover of inventory is essential to assure shipping of fresh product and prevent excessive spoilage during storage and shipping.

- In addition to the bookkeeping involved in monitoring inventory, the grower must protect the crop. Storage in a controlled, refrigerated environment is necessary after harvest. Atmospheric control of gasses and moisture is also necessary to protect product quality. Packaging, frequent inspection, and moving the produce as quickly as possible will prevent loss through spoilage.

- These steps should be taken during shipment as well as during storage. The use of ice, refrigerated trucks and railroad cars, and specially designed aircraft and ships' storage compartments make this possible.

- Seemingly minor details, such as how the produce is stacked and what size/style containers are most appropriate, must be carefully determined. Plants that give off ethylene gas of other chemicals must be stored separately. Air circulation is necessary for proper cooling. Good ventilation also prevents a buildup of gasses which may cause spoilage. Stacking in rows, layers, and stacks, with adequate air circulation space, is recommended.

- Containers for produce should be easily accessible for rapid movement into and out of storage facilities.

ASSIGNMENT SHEET 1

Development of:
READING SKILLS
WRITING SKILLS
EMPLOYABILITY SKILLS

- Introduce the assignment to the students by discussing why reading, writing, and employability skills are important.
- Discuss with them the following skills which are relevant to this task:

  READING

  - Interpreting forms and records

  WRITING

  - Completing forms and records

  EMPLOYABILITY

  - Mastering a specific job task/procedure
  - Practicing good work habits/attitudes

- If students have difficulty interpreting forms and records:
  - Examine the structure of the forms being used.
  - Review the terminology on the form.
  - Review the purpose of the form.
  - Have students identify information recorded on more than one form.
  - Explain the chronological use and relationship between each form.
- If students have difficulty completing forms and records:
  - Examine the structure of the forms being used.

  - Stress the importance of accurate, legible records.
  - Review the use of each form.
  - Identify alternate forms which can be referred to for the appropriate information.

- If students have difficulty mastering a specific job task/procedure:
  - Emphasize the fact that practice makes a person proficient and proficiency makes a person confident.
  - Suggest they study each component of the procedure to determine which area is causing difficulty.
  - Review the entire procedure.
  - Team them with proficient students or professionals to practice the procedure.

- If students have difficulty practicing good work habits/attitudes:
  - Encourage them to become familiar with the entire procedure before they begin the work.
  - Discuss the role that good work habits and attitudes have in obtaining and retaining employment.
  - Discuss what behaviors and attitudes constitute good work habits.
  - Make sure the student knows what is expected of him or her.

ASSIGNMENT SHEET 2

Development of:
WRITING SKILLS
EMPLOYABILITY SKILLS
SOCIAL STUDIES SKILLS

- Introduce the assignment to the students by discussing why writing, employability, and social studies skills are important.
- Discuss with them the following skills which are relevant to this task:

WRITING

- Completing forms and records
- Writing instructions

EMPLOYABILITY

- Mastering a specific job task/procedure

SOCIAL STUDIES

- Interpreting maps/globes

- If the student has difficulty writing instructions:
  - Have the student break the activity down into steps, then arrange those steps in chronological order.
  - Have students identify how each step relates to preceding and following steps.
  - Discuss the importance of clear, logical instructions.
- If students have difficulty interpreting maps/globes:
  - Examine and define the various components of a map.
  - Discuss the purpose of the map.
  - Discuss the types of information that can be conveyed by a map.
  - Examine the orientation, legend and scale of the map.
  - Demonstrate how to determine mileage between cities.
  - Demonstrate how to identify types of roads.
- For additional suggestions on teaching basic skills, refer to suggestions for Assignment Sheet 1.

ASSIGNMENT SHEET 1

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE

XI

Name ______________________________ Score __________

OBJECTIVE 7 **Prepare inventory and shipping forms.**

INTRODUCTION

Proper shipping records must be kept by any business. Such records are used by all businesses, and a familiarity with them will be useful in many careers.

DIRECTIONS

Transfer the information listed on the purchase order to the packing slip, invoice, and bill of lading. Assume that each commodity is shipped in a separate container.

Functional Reading Skills
- Interpret forms and records

Functional Writing Skills
- Complete forms & records

Job Acquisition/ Development Skills
- Master a specific job task/procedure
- Practice good work habits/attitudes

Purchase Order

Cousin Cal's
Super Store

PURCHASE ORDER

502 W. Third • Anywhere, OK 76000 • (405) 000-3049

DATE	FUND	AGENCY	ACCOUNT	OBJECT CODE	Bd. of Affairs Cont. #	PURCHASE ORDER NO. PLEASE REFERENCE THIS # ON ALL CORRESPONDENCE
10/20/92			422	PRO		
SOURCE	DIVISION	OBJECT	LEVEL	CLASSIFICATION	SUBJECT	FUND-YR
						3691

TO: NUTS-4-U
1214 S. WALNUT
CASHEW, OK 74000

SHIP TO:
SAME

REGISTRATION FOR TAX FREE TRANSACTIONS UNDER CHAPTER 32 OF THE INTERNAL REVENUE CODE NO. 73-73-0163K

ITEM NO.	QUANTITY	UNIT	DESCRIPTION	UNIT PRICE	AMOUNT
1.	12	lbs.	CASHEWS	1.79	21.48
2.	20	lbs	PEANUTS	.69	13.80
3.	10	Lbs	ALMONDS	1.49	14.90

TERMS:	☛ UNLESS OTHERWISE INDICATED, ALL PRICES ARE F.O.B. DESTINATION	DELIVER ON OR BEFORE 11/7/92	TOTAL AMOUNT $ 50.18

AUDIT CLAUSE: In accepting any contract with the State, the Vendor must agree to the audit clause which provides that books, records, documents, accounting procedures, practices or any other items of the service provider relevant to the contract are subject to examination by the agency and the State Auditor and Inspector

VENDOR'S INSTRUCTIONS

1. Purchase Order Number Must Appear On
   a. Each Individual Invoice
   b. Each Individual Credit Memorandum
   c. Outside Each Package or Carton
   d. All Correspondence Pertaining To This Order
2. Prices Are Exclusive Of Federal and State Taxes
3. All Invoices Must Include F.E.I./S.S. Number
4. Send Triplicate Invoices (With One Marked "Original Invoice") To

I CERTIFY I AM AUTHORIZED TO ORDER FOR THIS AGENCY AND THAT FUNDS FOR PAYMENT OF THIS ORDER ARE AVAILABLE

BY

PURCHASING AGENT

Cousin Cal's Super Store
502 W. Third
Anywhere, OK 76000

Packing Slip

Nuts-4-U
1214 S. Walnut
Cashew, OK 74000

PACKING SLIP

Invoice Date:
Invoice No.:
Customer's No.:
Date Shipped:
How Shipped:
Terms: Net 30:

SOLD TO:	SHIP TO:

Qty	Description	Stock No.		

Cartons __________

Invoice

Invoice Date:
Invoice No.:
Customer's No.:
Date Shipped:
How Shipped:
Terms: Net 30:

Nuts-4-U
1214 S. Walnut
Cashew, OK 74000

BILL TO:

SHIP TO:

QUANTITY	DESCRIPTION	ID#	UNIT PRICE	AMOUNT

TOTAL:

PLEASE PAY THIS AMOUNT

Remittance must be made in U.S. dollars.

- *Invoice number must appear on checks.*
- *Please return green remittance invoice with check.*
- *Federal I.D. Number 00-001234A*
- *NO RETURNS ACCEPTED WITHOUT AUTHORIZATION.*

Make checks payable to:
Nuts-4-U

ASSIGNMENT SHEET 1 - Fruit and Nut
CIMC - XI - 21

Bill of Lading

UNIFORM STRAIGHT BILL OF LADING

39392
ORIGINAL

DATE ____________________

FROM: AT

CONSIGNED TO DESTINATION

CARRIER Route:

No Pkgs	DESCRIPTION OF ARTICLES, SPECIAL MARKS AND EXCEPTIONS	* WEIGHT (SUB TO COR.)	Class or Rate

SUBJECT TO SECTION 7 OF CONDITIONS, IF THIS SHIPMENT IS TO BE DELIVERED TO THE CONSIGNEE WITHOUT RECOURSE ON THE CONSIGNOR, THE CONSIGNOR SHALL SIGN THE FOLLOWING STATEMENT:
THE CARRIER SHALL NOT MAKE DELIVERY OF THIS SHIPMENT WITHOUT PAYMENT OF FREIGHT AND ALL OTHER LAWFUL CHARGES.

(SIGNATURE OF CONSIGNOR)

IF CHARGES ARE TO BE PREPAID, WRITE OR STAMP HERE "TO BE PREPAID"

RECEIVED $ ____________
TO APPLY IN PREPAYMENT OF THE CHARGES ON THE PROPERTY DESCRIBED HEREON

AGENT OR CASHIER

PER ____________
(THE SIGNATURE HERE ACKNOWLEDGES ONLY THE AMOUNT PREPAID.)

CHARGES ADVANCED
$ ____________

This Shipment will be forwarded open unless C.O.D. Amount is filled in here **C.O.D. $**

C.O.D. CHARGE TO BE PAID BY ☐ CONSIGNEE ☐ SHIPPER

NOTE — Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding

REMARKS

Carrier's Signature or Stamp

SHIPPER'S ADDRESS

By

*THIS SHIPMENT IS TENDERED AND RECEIVED SUBJECT TO THE TERMS AND CONDITIONS OF THE CARRIER'S BILL OF LADING AS FILED WITH THE INTERSTATE COMMERCE COMMISSION, NOT NEGOTIABLE

ASSIGNMENT SHEET 2

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE

XI

Name ________________________________ Score ____________

OBJECTIVE 8

Write a loading order for a delivery truck route.

INTRODUCTION

In a drop shipment delivery system, the truck is driven to a customer's business and the order delivered, then it is driven to the next customer and that delivery is made. A delivery truck may make 30 drop shipments in one day on a single route.

The driver has a predetermined list of delivery stops and instructions as to what to deliver first and last. This is important because trucks are loaded according to the delivery stops.

Orders are placed in the truck or trailer from front to back; the first items placed in the truck or trailer are placed closest to the cab. These are the last to be delivered.

Trucks are loaded in reverse order of the delivery stops. Items in the last delivery stop are loaded first and items for the first delivery stop are loaded last.

This loading order makes it easy for the delivery person to unload each customer's order. All items in a customer's order are grouped together and labeled so the driver can easily see what needs to be unloaded. The next customer's order is always the next most available.

Some businesses use ribbon or string to mark off each order. Others don't separate orders so clearly.

Invoices, usually kept on a clipboard, accompany the shipments and detail the products to be unloaded at each stop.

DIRECTIONS

Use the information provided with each question to determine the requested answer.

Functional Writing Skills
- Complete forms & records
- Write instructions

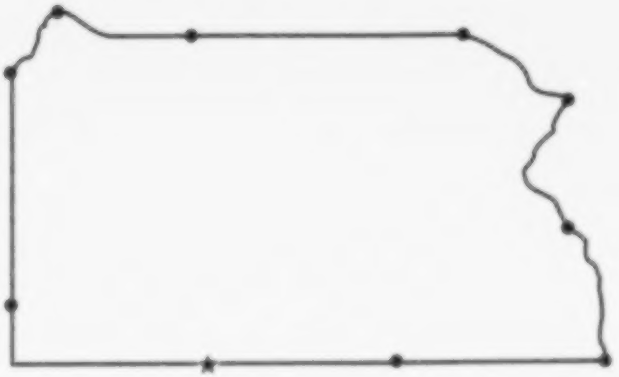
Your peach orchard has just gained enough new customers to start another truck delivery route. Your business is located in Stillwater and the new East route has customers in Perry, Tonkawa, Ponca City, Pawhuska, Cleveland, Hominy, Blackwell, Mannford and Yale.

Job Acquisitions/ Development Skills
- Master specific job task/procedure

Information Analysis Skills
- Interpret maps/globes

1. Locate the towns on a map and write in their names on the map of north central Oklahoma below.

Blackwell
Cleveland
Hominy
Mannford
Pawhuska
Perry
Ponca City
Tonkawa
Yale



2. Determine how the route will be delivered. With Stillwater as number 1, number the towns to show the first delivery stop, the second, and so on to the last delivery stop. Draw arrows along the line connecting the towns to indicate the direction of travel.

3. This week's order includes:

Blackwell Consumers Mkt	300	lbs. watermelons
	6	cases strawberries
Cleveland Convenience Foods	25	lbs. cantaloupes
Hominy Wilson's Foods	11	cases peaches
	20	lbs. pumpkins
	15	lbs. cantaloupes
Mannford IGA	10	lbs. walnuts
	200	lbs. watermelons
	6	cases strawberries

Pawhuska Food Co-op	12	lbs. walnuts
	20	lbs. peaches
	25	lbs. cantaloupes
	2	cases strawberries
	120	lbs. watermelons
Perry Food Hut	35	lbs. pumpkins
	15	lbs. cantaloupes
	25	lbs. peaches
	6	lbs. walnuts
Ponca City Food Warehouse	100	lbs. watermelons
	15	lbs. cantaloupes
	15	lbs. pumpkins
	6	cases strawberries
	10	lbs. peaches
	5	lbs. walnuts
Tonkawa Homeland	30	lbs. pumpkins
	150	lbs. watermelons
	5	cases strawberries
	10	lbs. walnuts
Yale E & E Grocers	5	cases strawberries
	15	lbs. walnuts
	20	lbs. peaches
	30	lbs. cantaloupes

A new driver will be delivering this route, so prepare a list of how the orders should be loaded into the truck and what products will be delivered to each customer. Fill out the form showing in what order to load the truck and what products to deliver to each customer.

Truck loading order	Customer name	Location	Items to be delivered
1 (first)			
2)			

Truck loading order	Customer name	Location	Items to be delivered
3)			
4)			
5)			
6)			
7)			
8)			
9 (last)			

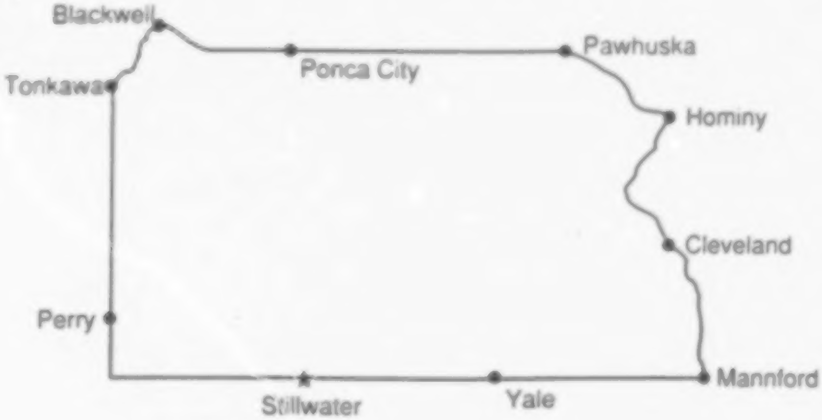
ASSIGNMENT SHEET 1

Make sure all information has been transferred completely, accurately, and neatly.

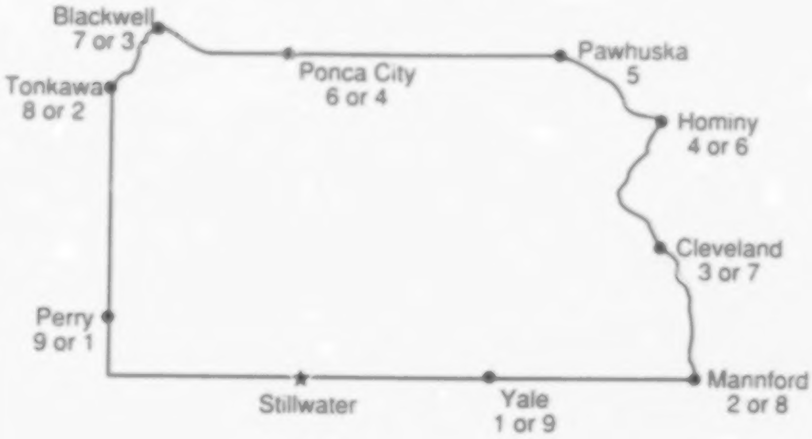
ASSIGNMENT SHEET 2

Use the following criteria for evaluation:

1.


Blackwell
Ponca City
Pawhuska
Tonkawa
Hominy
Cleveland
Perry
Mannford
Stillwater
Yale

2. The student must understand that the delivery route would make a continuous loop so the fewest miles are driven. The route may begin at Yale and circle around to Perry (last stop) or begin at Perry and circle around to Yale, as long as the loop shown below is followed.


Blackwell
7 or 3
Ponca City
6 or 4
Pawhuska
5
Tonkawa
8 or 2
Hominy
4 or 6
Cleveland
3 or 7
Perry
9 or 1
Stillwater
Yale
1 or 9
Mannford
2 or 8

3. The list must be loaded in reverse order of the student's chosen delivery route: last delivery stop loaded first and first delivery stop loaded last.

   Students should understand the importance of reverse loading. A loading order should be clearly written so shipping personnel can accurately fill the orders.

WRITTEN TEST

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE

XI

Name ______________________________ Score ____________

OBJECTIVE 1

Match terms associated with taking inventory, shipping, and maintaining merchandise to their correct definitions. Write the correct letter in the blank.

_____ 1. Group of people employed by the operation

_____ 2. 1) The stock on hand 2) an accounting of the stock on hand 3) the act of counting the stock on hand

_____ 3. Anything owned that has value

_____ 4. Debts owed

_____ 5. Payment for work done

_____ 6. 1) Written records of actions or exchanges; 2) the paper the records are kept on

_____ 7. Money made available by a bank or lender

a. account

b. assets

c. budget

d. compensation

e. credit

f. documents

g. inventory

h. labor

i. ledger

j. liabilities

k. manpower

OBJECTIVE 2

Select from a list true statements about federal and state shipping standards and regulations. Write an "X" in the blank before each true statement.

_____ 1. Transportation regulations are restricted to protecting the quality of food shipped.

_____ 2. Transportation regulations protect the grower by prohibiting infestation.

_____ 3. Trucks licensed for transporting food cannot also transport pesticides.

May be photocopied for student use.

_____ 4. Transportation regulations protect consumers by insuring safe handling and storage practices.

_____ 5. Pests such as the Mediterranean Fruit Fly are controlled by irradiating fruit.

_____ 6. Regulations may be tailored to meet the needs of an individual state agricultural community.

_____ 7. Disease or infestation in one state or region will be controlled with voluntary state quarantines.

OBJECTIVE 3

Discuss why good record keeping is important. Answer the following questions.

1. What do financial status records indicate and what are they used for?

____

____

____

____

2. The manager of Doubletree Farms knows that she will be shipping 17% more peaches next month than this month and will have to adjust the crew size and the picking and packing schedule. What type of record keeping provides this information?

____

3. What three types of information are documented in administrative records?

____

____

____

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4. Shipping records document when and by what method shipments are made or received. What additional advantages do they offer the grower?

____

____

____

5. Jordan operates maintenance equipment for an orange production operation. His employer keeps labor records that also reflect the hours he has worked each two-week period, each month, and throughout the year. What additional information will be kept in the labor records?

____

____

OBJECTIVE 4

Match records to their descriptions. Write the correct letter in the blank.

Part I

_____ 1. Shows the net worth of a business at the end of the year by subtracting assets from liabilities

_____ 2. A record of monthly cash income and expenses

_____ 3. Documents each financial transaction

_____ 4. Summarizes information about expenses and income over a given period of time

_____ 5. Lists the operation's assets and liabilities to determine its value

_____ 6. A written plan to compare alternative courses of action

a. annual business budget
b. balance sheet
c. cash flow summary
d. income statement
e. inventory status records
f. invoice
g. net worth statement
h. sales records
i. tax records
j. bill of lading

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Part II

_____ 1. List what goes into a product, how it is assembled, and where the raw materials are obtained

_____ 2. List what should be on hand and is checked by actually counting produce

_____ 3. Set timetable for planting, harvesting, treating, storage, and shipment

_____ 4. Records product transportation and costs, including inspection

_____ 5. Measure efficiency and effectiveness

_____ 6. Record of losses; may be used to pinpoint problems in transportation or storage

_____ 7. Money spent to insure that machinery and tools are in proper working order

_____ 8. Show that government regulations are followed; include applications, compliance forms, and other types of reports

_____ 9. Important for proving that safe chemicals are used, are used correctly, and government restrictions are followed

a. bill of lading

b. chemical or spraying records

c. cost records

d. inventory status records

e. invoice

f. equipment records

g. product structure records

h. scheduling plans and records

i. shipping requisition

j. spoilage records

k. time records

l. cash flow summary

m. compliance records

n. transportation records

o. shipping status records

May be photocopied for student use.

Part 3

_____ 1. Billing for shipment

_____ 2. Records that an order has been placed, what was ordered, method of payment, etc.

_____ 3. Accompanies the shipment and is used by the shipper to specify how many containers are shipped, where they are to be delivered, etc.

_____ 4. May include simple wages or salary, or may include profit sharing, insurance, or other benefit information

_____ 5. Lists date of hire, record of performance, etc.

_____ 6. Records hours worked, sick leave and vacation time due and taken

_____ 7. W2, W4 forms and appropriate withholdings and payments

a. balance sheet

b. bill of lading

c. compensation

d. cost records

e. evaluation/ employment history

f. invoice

g. sales records

h. shipping requisition

i. spoilage records

j. tax forms

k. time records

OBJECTIVE 5

Complete statements about maintaining inventory. Write the correct word or phrase in the blanks.

1. Care should be taken to see that all records match, that the amount of material shipped is actually what is stated on the invoice and on the ____________________

2. The record that indicates that something has been received and put into storage is the ____________________

3. The shipping requisition indicates that something has been

____

4. The document that shows all transactions is the final

____

May be photocopied for student use.

OBJECTIVE 6

Choose words or phrases that complete statements about storing plants and materials. Write the correct letter in the blank.

_____ 1. General considerations for proper storage include putting produce that give off chemicals into a separate area, proper air circulation, good ventilation, and

- a. good lighting
- b. specific temperatures
- c. stacking in rows and layers
- d. proper amount of darkness

_____ 2. Rapid turnover of inventory is important in storing produce because it can prevent

- a. the growth of microbes
- b. excessive spoilage
- c. delayed shipments
- d. excessive atmospheric controls

_____ 3. Loss through spoilage can be prevented by

- a. picking produce early, processing while underripe, and ripening with gas and chemicals
- b. packing, frequent inspection, and moving produce as quickly as possible
- c. fast turnover of produce, automated packaging, and good record-keeping procedures
- d. delaying packing, controlling moisture, and limiting the amount of handling

_____ 4. Atmospheric control of gasses and moisture are used to

- a. protect product quality
- b. hasten ripening
- c. delay ripening
- d. reduce processing costs

NOTE: Objectives 7 and 8 are evaluated on assignment sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use

WRITTEN TEST ANSWERS

TAKE INVENTORY, SHIP, AND MAINTAIN MERCHANDISE

XI

OBJECTIVE 1

1. h
2. g
3. b
4. j
5. d
6. f
7. e

OBJECTIVE 2

2, 3, 4, 6

OBJECTIVE 3

1. Financial status records indicate the current assets and liabilities. They are used to determine taxes and to apply for loans or other credit.
2. Inventory records
3. Equipment is properly maintained, chemicals used are safe and documented, and government regulations are followed.
4. Help maintain an accurate inventory count and trace lost deliveries
5. Taxes withheld, salaries, and performance evaluations

OBJECTIVE 4

Part 1	Part 2	Part 3
1. b	1. g	1. f
2. c	2. d	2. h
3. h	3. h	3. b
4. d	4. n	4. c
5. g	5. c	5. e
6. a	6. j	6. k
	7. f	7. j
	8. m	
	9. b	

OBJECTIVE 5

1. packing sheet
2. bill of lading
3. removed from storage
4. inventory

OBJECTIVE 6

1. c
2. b
3. b
4. a

OBJECTIVE SHEET

SELL FRUIT AND NUT CROPS

XII

INTRODUCTION

Selling fruit and nut crops involves some important decision making. Growers have several choices, and must decide on the best way to sell or market a crop to meet their profit goals. It is important for growers to know their marketing options and the advantages and disadvantages of each. Remember, these considerations need to be thought out even before getting into the fruit and nut production business. Planning is critical. But when planning is done right, the results will be rewarding and profitable.

UNIT OBJECTIVES

After completing this unit, the student will know advantages and disadvantages of direct and non-direct markets, and liability factors to consider with direct markets. The student will be able to write an advertisement for a pick-your-own operation, and determine the feasibility of a pick-your-own strawberry farm. The student will demonstrate these competencies by completing the assignment sheets and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to:

1. Match terms associated with selling fruit and nut crops to their correct definitions.
2. List advantages and disadvantages of direct marketing and non-direct marketing.
3. Match types of non-direct markets to statements describing them.
4. Describe types of direct markets.
5. Complete sentences explaining considerations in establishing a direct market.
6. Select from a list true statements regarding direct marketing liability.
7. Select from a list various resources for growers.
8. Identify attributes of a good employee.
9. Identify characteristics of a good supervisor.

10. Write a newspaper advertisement for a pick-your-own operation. (Assignment Sheet 1)

11. Determine the feasibility for a pick-your-own strawberry farm. (Assignment Sheet 2)

SUGGESTED ACTIVITIES

SELL FRUIT AND NUT CROPS

XII

PREPARATION

- Order materials to supplement unit.

  NOTE: See Suggested Resources.

- Review unit and plan presentation.

- Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.

- Determine scope and sequence of objectives that you add. Design and develop support materials, including evaluation techniques, for additional objectives.

- Review teaching suggestions and plan classroom activities.

- Determine how you will schedule time for students to demonstrate competence in the required procedures.

- Invite guest speakers.

  NOTE: Supply guest speakers with the Objective Sheet, Information Sheet, and any other components you want them to cover.

DELIVERY

Objective 1: Match terms associated with selling fruit and nut crops to their correct definitions.

Objective 2: List advantages and disadvantages of direct marketing and non-direct marketing.

Objective 3: Match types of non-direct markets to statements describing them.

Objective 4: Describe types of direct markets.

- Go over terms in Information Sheet; give examples, when possible, to make terms more understandable.

- Discuss direct and non-direct markets; ask students to think of examples of each in their area. These may be places you could visit.

- Draw a flow chart of the route produce takes after it is picked; show the various routes it may take before it ultimately reaches the consumer.

- Ask students to think of advantages and disadvantages of direct and non-direct marketing that may not be on the information sheet.

- Go over the types of direct and non-direct markets. Discuss which ones are most often used by growers in your area. Compare that information to the ways produce is sold in other states – such as California, where crops are grown in larger volumes.

- Arrange field trips to various direct and non-direct markets.

- Visit a local grocery store and find out how much local produce is sold there. Have students survey other businesses in the area, such as restaurants and institutions, to find out whether they purchase locally grown produce and ask why or why not.

Objective 5: Complete sentences explaining considerations in establishing a direct market.

- Discuss points to consider when establishing a direct market.

- Talk to local growers who operate direct markets and ask why they have chosen this method.

- Ask students to write down ways to promote a direct market. Discuss flyers, exhibits at local fairs and festivals, sponsorship of activities, opening up operations to school classes, etc.

- Use OSU Extension Fact Sheet No. 186, "Should I Grow Fruits and Vegetables?" to show an example of a roadside stand design and floor plan from the U.S. Department of Agriculture, and discuss the information on sign readability.

- Ask students to find a local roadside stand and have them design a sign for that operation.

- Discuss the importance of growing and selling quality produce as a way to keep customers coming back.

- Have students interview local growers to find out the best-selling crops. Discuss how farmers can pool their produce at a farmers' market or roadside stand to give people "one-stop" shopping.

Objective 6: Select from a list true statements regarding direct marketing liability.

- Emphasize the importance of being aware of liability.
- Have students visit a pick-your-own or other direct market and write down any problem areas they might see; discuss these as a class.
- Discuss labor laws, including child labor laws, minimum wage, and workman's compensation.
- Invite a lawyer who is well-versed in labor laws to visit the class, or ask a representative from an insurance company to talk to students about coverage. Discuss costs of coverage.

Objective 7: Select from a list various resources for growers.

- Discuss resources for growers and orchard or field workers.
- Invite representatives from local or national fruit and nut associations to talk to the class about their functions.
- Ask representatives from a local extension office or farm bureau to talk to the class about the ways they can help local growers.

Objective 8: Identify attributes of a good employee.

Objective 9: Identify characteristics of a good supervisor.

- Discuss the importance of being a good employee and a good supervisor. Many of the attributes of being a good employee, such as treating others with respect, go along with being a good employer.
- Do some role-playing exercises and put students in the situation of a supervisor who is: 1) discussing a problem with an employee, 2) rewarding an employee for a job well done, 3) approaching an employee who is wasting time, 4) listening to an employee who has a complaint or suggestion.
- Bring in an employer or supervisor in the fruit and nut production business and have them discuss common employee-employer problems.

APPLICATION

Objective 10: Write a newspaper advertisement for a pick-your-own operation. (Assignment Sheet 1)

- Have students practice writing a newspaper ad for a direct market operation.
- Have students complete Assignment Sheet 1.

Objective 11: Determine the feasibility for a pick-your-own strawberry farm. (Assignment Sheet 2)

- Give students some population figures, and acreage of already-established markets for a particular area and have them practice determining the feasibility of another pick-your-own farm.
- Have students complete Assignment Sheet 2.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.

  NOTE: The written test may be given in sections if desired.

- Give the written test.
- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

- Lloyd, Renee M., James R. Nelson, Raymond Joe Schatzer, Daniel S. Tillye, and Raleigh A. Jobes. "Should I Grow Fruits and Vegetables? Identifying and Evaluating the Possibilities," No. 180. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Lloyd, Renee M., James R. Nelson, and Shane Westphalen. "Should I Grow Fruits and Vegetables? Non-direct Marketing for Fruits and Vegetables." No. 182. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Lloyd, Renee M., Daniel S. Tilley, and James R. Nelson. "Should I Grow Fruits and Vegetables? Pick-Your-Own Markets." No. 184. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Lloyd, Renee M., James R. Nelson, and Daniel S. Tilley. "Should I Grow Fruits and Vegetables? Farmers' Markets." No. 185. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Lloyd, Renee M., James R. Nelson, and Daniel S. Tilley. "Should I Grow Fruits and Vegetables? Roadside Stands." No. 186. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.

UNIT REFERENCES

- Childers, Norman F. *Modern Fruit Science.* Horticultural Publications, Gainesville, FL, 1983.
- Courter, John W. "Estimating the Trade Area and Potential Sales for a Pick-Your-Own Strawberry Farm." HM-6-82. Cooperative Extension Service, University of Illinois at Urbana-Champaign, College of Agriculture: Urbana-Champaign, IL.
- Lloyd, Renee M., James R. Nelson, Raymond Joe Schatzer, Daniel S. Tillye, and Raleigh A. Jobes. "Should I Grow Fruits and Vegetables? Identifying and Evaluating the Possibilities," No. 180. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
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- Lloyd, Renee M., James R. Nelson, and Daniel S. Tilley. "Should I Grow Fruits and Vegetables? Roadside Stands." No. 186. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- *Project 2000 for Agricultural Education: An Instructional Unit on Fruit Production.* Iowa Department of Public Instruction, 1982.
- Scheer, Arnold H., and Elwood M. Juergenson. *Approved Practices in Fruit and Vine Production.* The Interstate Printers & Publishers, Inc.: Danville, IL, 1976.
- *Teaching and Technical Information for Horticulture: Fruit and Vegetable Production and Marketing,* Book 1. Iowa Curriculum Assistance System, Iowa State University: Ames, IA, 1985.
- Tilley, Daniel S., Douglas Moesel, and James R. Sleper. "Fresh Produce Marketing Alternatives for Oklahoma Fruit and Vegetable Growers." No. 473. Cooperative Extension Service, Oklahoma State University: Stillwater, OK, n.d.
- Uchtmann, Donald L. "Liability and Insurance for U-Pick Operations." HM-2-79. Cooperative Extension Service, University of Illinois at Urbana-Champaign, College of Agriculture: Urbana-Champaign, IL.

INFORMATION SHEET

SELL FRUIT AND NUT CROPS

XII

OBJECTIVE 1

Match terms associated with selling fruit and nut crops to their correct definitions.

- **commission** – percentage of money earned, usually by a broker or salesperson, when a product is sold
- **direct marketing** – growers deal directly with the final consumers when selling their produce

  EXAMPLES: Pick-your-own operations, roadside stands, and farmers' markets
- **liability** – legal responsibility or obligation to make good on any loss or damage that might occur because of negligence
- **non-direct marketing** – when selling their produce growers deal with an intermediary or "middleman" rather than directly with consumers

  EXAMPLES: Terminal markets, packing houses, wholesalers, cooperatives, brokers, restaurants, and grocery stores
- **retailer** – buyer of a product who sells to the final consumer

OBJECTIVE 2

List advantages and disadvantages of direct marketing and non-direct marketing.

DIRECT MARKETING

Advantages:

- Lower transportation costs
- Special containers may not be needed
- Produce need not be all of the same grade
- Producers can offer "recreation" at selling sites
- High-quality produce is sold for competitive retail prices
- Payment is received at time of sale

Disadvantages:

- Liable for accidents on property
- Must attract a certain volume of customers to meet expenses
- Need good location and facilities (weigh stations, restrooms, etc.)
- Must deal directly with customer
- Requires more personal time
- Harvesting throughout growing season requires more production planning
- Additional labor may be needed for selling, field assistance

NON-DIRECT MARKETING

Advantages:

- Large number of potential buyers
- Can sell most or all of crop at one time
- Produce can be sold quickly
- Less personal time required
- Market information available

Disadvantages:

- High quality, uniform produce needed
- Special containers often required
- Large quantities needed to cover transportation costs
- Payment usually not received at time of delivery

OBJECTIVE 3

Match types of non-direct markets to statements describing them.

- **Broker** – person or firm that negotiates sales contracts between buyers and sellers, but does not buy the produce outright; brokers try to find the best quality produce for fair prices for both buyers and sellers

  NOTE: Brokers are usually paid on a percentage commission based on the selling price of the produce.

- **Cooperative** – packing facility that involves the membership of numerous local growers; most cooperatives provide services such as harvesting, grading, packing, cooling, storage, and transportation services; members pool their produce to meet buyer requirements they may not be able to meet alone

- **Mail order** – means of providing "packaged" produce or gift packs through catalogs or local advertisements; growers can put together "fruit and nut" gift packages that can be sold year-round; when the fruit is not in season, dried fruit can be incorporated into the package

  NOTE: The key is to be creative. "Gourmet" packages are popular and attractive gift ideas for the holidays or special occasions and are a good way to promote your product. Consider variety packs that include produce and products that are made in your state. These can be marketed as gift ideas to the large employers in your area.

- **Private packing facility** – facility that grades, packs, cools, and sells produce for growers; these facilities may also help with harvesting, financing, managing field operations, delivering produce, and leasing equipment

- **Processors** – processing plants that generally contract with growers to buy their produce and then redistribute it after it has gone through a process such as canning, freezing or drying; processors may provide harvest assistance

- **Retail outlets** – grocers, restaurants, or institutions such as hotels, schools, prisons, and hospitals, that purchase produce directly from the grower

- **Terminal market** – assembly and distribution center in a large metropolitan area; growers truck their produce in large quantities to the market and there buyers purchase and redistribute the produce to local markets

- **Wholesaler** – person or business that buys large quantities of produce from growers or other dealers and then sells the product to others who plan to resell it

OBJECTIVE 4

Describe types of direct markets.

- **Farmers' markets** – outlets for growers to sell produce directly to consumers; buyers are usually attracted by the variety of produce sold at one location. Growers are usually assessed a fee to sell the produce
- **Pick-your-own** – an operation in which a grower allows consumers to harvest their produce from his or her fields or orchards
- **Roadside market** – a facility, usually on the grower's property, used to sell locally grown produce or produce purchased from nearby growers; market is usually on a well-traveled roadway to attract passersby

OBJECTIVE 5

Complete sentences explaining considerations in establishing a direct market.

- **Advertising and promotion** – Growers need to **promote** their products through means such as **roadside** signs, billboards, flyers, newspaper and radio advertisements, and **direct mailing** such as postcards. Names can be taken from customers' checks or from a mailing signup sheet of interested customers.
- **Pricing** – Growers often use **competitors'** prices as a way to determine prices for their produce. Produce can be sold by **weight**, **volume**, or **count** (per item). Producers need to take into account production costs, expected sales, and yields when setting their selling prices.
- **Optional facilities** – Growers can make their operations more **attractive** to customers by providing such services as restrooms, **picnic tables**, play areas for children, refreshments, and rest or recreation areas. The harvesting season can be made festive by offering special events such as summer plays, concerts or musicians on the grounds.
- **Containers** – Growers need to supply **sturdy containers** that will not harm the fruit and are easy for pickers to **carry**. To cut costs, some types of fruits can be transferred to less expensive containers, such as paper or plastic bags, after being purchased.

- **Labor** – The type and amount of labor needed will depend on the **operation.** Most pick-your-own facilities will need, at minimum, people to **supervise** pickers in the field and **check station** operators to give directions and take payments.

- **Liability** – When growers open their land to the public, they **increase** their liability. Producers need to do all they can to make sure their **property** is safe, and check with their insurance agents to make sure they have proper coverage.

  NOTE: If a grower provided ladders to customers, it could significantly increase his/her liability.

- **Location** – Sites should be **well-marked**, and directions should be clear. Growers need to consider possible **competition** from other nearby operations and determine the number of potential customers in the area.

- **Consumer Interest** – Growers need to consider the type of **residents** in the area and their reasons for visiting a pick-your-own operation, produce stand, or farmers' market. Reasons may include **lower** prices, **fresher** produce, and variety.

- **Quality** – Quality of produce is important because it can determine how many customers will visit an operation. Quality also determines the **prices** a grower can set, the number of **repeat** sales, and the word-of-mouth advertising a grower can expect.

OBJECTIVE 6

Select from a list true statements regarding direct marketing liability.

- Growers are only liable to an injured customer if the grower or employees have NOT exercised reasonable care under the circumstances.

- In the case of a social guest or trespasser, the grower's only duty is to avoid "willful and wanton" misconduct.

- Growers must consider product liability. If the produce is dangerous – for example, contaminated with chemicals – then the grower may be held liable for any illness or injury it may cause a consumer.

- Growers must be aware of possible damages. Producers, or their insurance companies, may be sued for **actual damages**, which could include the cost of medical bills, lost wages, and pain and suffering. In addition, if a jury decides a grower may have acted recklessly, it could award **punitive damages** to discourage such reckless action from happening again.

- Growers need to survey possible problem areas to cut down the chance of liability. Check entrances and parking areas for traffic danger; check picking site for hazards such as tree stumps; if transporting customers to picking areas, vehicle safety must be checked. Post warning signs if that is the only way to caution people.

- Growers should check with their insurance companies to make sure they have adequate coverage for the type of operation they are running.

- Growers are responsible for the welfare of their employees on the job, just as they are for visitors and customers. Depending on the type of business, workman's compensation laws may apply. These laws allow injured workers to collect damages, no matter who was at fault.

- Growers who hire employees to care for orchards and fields and to pick produce must be aware of labor laws. The U. S. Department of Labor is a good source of age, pay, and job requirements.

  EXAMPLE: Minors under the age of 16 are barred from performing some hazardous farm jobs such as operating certain machinery and handling some chemicals. A brochure outlining those jobs is published by the Department of Labor.

OBJECTIVE 7 **Select from a list various resources for growers.**

- The Packer's Red Book – lists industry businesses, types of fruits and vegetables they buy or sell, their specific function in the industry, their credit rating, and the level of sales of the company

- The Blue Book – an industry list that gives more detailed financial reports, indicating the reliability of a particular business's credit

- Local colleges and universities

- Cooperative extension services and farm bureaus

- Local and national growers' associations – these associations help keep you up to date on labor laws, chemical regulations, and other important laws, The associations also sponsor seminars and conferences where local growers can exchange ideas.

  EXAMPLE: Oklahoma Pecan Growers Association

  NOTE: You can check at the reference desk of your local library for indexes to the various associations throughout the country.

- Perishable Agricultural Commodity Act (PACA) – prohibits unfair and fraudulent trade practices in the marketing of fresh and frozen fruits and vegetables; allows person(s) to collect damages if contract agreements are not met; requires commission brokers, dealers, and merchants handling fresh and frozen fruits and vegetables in interstate or foreign commerce to be licensed.

  NOTE: Information about PACA is available from the following agency: Regulatory Branch, Fruit and Vegetable Division, Agricultural Marketing Service, USDA. The agency can be contacted at two locations: (1) Washington, D.C. 20250, phone 202-737-7766; and (2) Federal Office Building, 819 Taylor St., Room 9003, Fort Worth, Texas, 76102, phone: 817-335-1630. Be sure to include the agency's full name when writing to either address.

OBJECTIVE 8 **Identify attributes of a good employee.**

A good employee should exhibit the following attributes:

- Greets customers in a personal and friendly manner

- Dresses appropriately for the job

  EXAMPLE: If an employee works in the field or with machinery, clothing should be selected for safety (long pants, no ties or strings that could get caught in machinery) and durability.

- Always shows up for job on time and works the number of hours that have been assigned

- Notifies or discusses with supervisor well in advance of any schedule conflicts or vacation plans.

  NOTE: Supervisors need time to find someone else to fill in on the job.

- Keeps a positive attitude on the job.

  NOTE: This will make the job more enjoyable for both the employee and co-workers.

- Keeps an open flow of communication with the supervisor

  NOTE: If an employee sees a way to improve or speed up a process, an informal meeting with the supervisor can be scheduled. Remember, good supervisors value the input of their employees.

- Does NOT waste time

  NOTE: If an employee finishes a job early or runs out of work, he/she should approach the supervisor to see if there are other duties that can be done.

OBJECTIVE 9 **Identify characteristics of a good supervisor.**

The following are characteristics that good supervisors should possess:

- The ability to motivate employees to perform to the best of their ability
- The ability to create a pleasant working atmosphere
- The ability to deal with many personalities

  NOTE: Some employees must be dealt with sternly while others need only gentle guidance.

- Takes a personal interest in each employee

  NOTE: The supervisor should know enough about the employee to ask about their spouse or children. Employees usually respond well to a person who is genuinely interested in them.

- The ability to treat each employee with respect

  NOTE: A supervisor should never treat an employee as a servant. Supervisors should never ask an employee to do something which they would not do themselves.

- The ability to listen to complaints or comments of employees

  NOTE: Because the employees are the ones who do the jobs every day, they are often more familiar with problems than the supervisor and, therefore, may have excellent suggestions or solutions.

- The ability to be understanding and compassionate when employees experience personal problems

  EXAMPLES: Death of a family member, divorce, personal or family illness, problems with children

- Good judgement in knowing when to be stern and when to be lax
- The ability to carry out the rule "treat employees as you would like to be treated"
- The ability to communicate regularly with employees one-on-one to evaluate their performance

  NOTE: Supervisors should reward employees for a good job. Criticism should be constructive.

STUDENT SUPPLEMENT 1

SELL FRUIT AND NUT CROPS

XII

To estimate the acres needed for a pick-your-own operation, a grower must consider the population of the primary trade area. This figure is expressed in thousands and includes people located within a 20-mile radius of the farm. The area should have good roads and be accessible.

Total production acres must also be considered. This figure tells the grower how many acres should be planted to support the primary trade area population. A grower will need to subtract the number of acres already planted by competitors from the total to arrive at the number of acres he/she needs to plant. Total production acres data is rounded off to the nearest full acre.

To determine how many acres to plant, you can use the chart below. For example, a primary trade area with a population of 500,000 could support 70 acres of strawberry plants. If Grower A planted 20 acres and Grower B planted 25 acres, Grower C could still plant 25 acres without over-saturating the area.

Estimates of Strawberry Acres for Pick-Your-Own (PYO) Marketing

Primary trade area population (in thousands)	Acres producing strawberries for PYO
2.5	1
5	2
10	4
20	8
30	11
40	15
50	18
60	21
70	24
80	27
100	30
150	37
200	44
250	51
300	58
400	64
500	70
600	75
700	81
800	86
900	92
1,000	98

ASSIGNMENT SHEET 1

Development of:
CREATIVE THINKING/PROBLEM SOLVING SKILLS

- Introduce the assignment to the students by discussing why creative thinking/problem solving skills are important.
- Discuss with them the following skills which are relevant to this task:

  CREATIVE THINKING/PROBLEM SOLVING

  - Creating a finished product
  - Applying intuitive thinking techniques
- If students have difficulty creating a finished product:
  - Review the information.
  - Instruct them to examine the goals of the assignment.
  - Instruct them to work one step at a time until the project is finished.
  - Suggest they write a plan for attaining their goal.
  - Review the action plan to determine whether it will bring the desired results.
  - Discuss the way in which the finished product is organized.
  - Review language skills.
  - Review the requirements of the assignment.
  - Suggest they use intuitive thinking techniques to formulate an idea.
- If students have difficulty applying intuitive thinking techniques:
  - Remind them that one idea stimulates another and they should keep going without judging or criticizing their ideas.

- Encourage them to trust their own informed thinking.
- Remind them that when working with others, all ideas are potential winners, and should be respected and accepted until time for discussion and evaluation.
- Get students involved in sharing ideas with a creativity-enhancing exercise, such as listing all the uses for a clothespin or activities such as those recommended in a book on creativity.

NOTE: *A Whack on the Side of the Head: How to Unlock Your Mind for Innovation* is a creativity activity book by Roger Von Oech and published by Warner Books, New York, 1983. Includes games, illustrations, exercises and self-evaluation tests.

ASSIGNMENT SHEET 2

Development of:
READING SKILLS
MATHEMATICS SKILLS
EMPLOYABILITY SKILLS
SOCIAL STUDIES SKILLS

- Introduce the assignment to the students by discussing why reading, mathematics, employability, and social studies skills are important.
- Discuss with them the following skills which are relevant to this task:

READING

- Finding materials in library
- Using standard references
- Using in-book references

MATHEMATICS

- Calculating with whole numbers
- Selecting/applying mathematical procedure
- Solving practical problems

EMPLOYABILITY

- Investigating employment prospects of a career field/occupation

SOCIAL STUDIES

  - Collecting/recording data
  - Interpreting maps/globes
  - Analyzing/interpreting demographic information
  - Analyzing consumer issues

- If students have difficulty finding materials in library:
  - Discuss the type of cataloging system in use.
  - Demonstrate the use of the cataloging system.
  - Instruct them to practice the use of the cataloging system.
  - Discuss the arrangement of the library.
  - Discuss the importance of being skilled in the use of the library.
  - Remind them that librarians are available to assist them.
  - Show students reference and agricultural information areas of the library.
- If students have difficulty using standard references:
  - Locate and explain the purpose of the reference section of the library.
  - Discuss the fact that each standard reference provides a specific type of information.
  - Review the contents of major agricultural references.
- If students have difficulty using in-book reference tools:
  - Discuss the content of the supplement and have students clarify how the information can be used to complete the assignment sheet.
  - Encourage students to use bookmarks or other devices to mark in-book references used most often.
  - Explain to students that books are "random access" tools, meaning the information in them is accessible in any order. Compare books to items which are not random access such as cassette tapes or video films.

  - Review terms used in the various references.

- If students have difficulty calculating with whole numbers:
  - Review basic skills in addition, subtraction, multiplication, and division.
  - Review mathematical terminology.

    EXAMPLE: "Compare" is an indication that you must subtract.

- If students have difficulty selecting and applying math procedures:
  - Instruct the students to reword the problem in a form that is clearer to them.
  - Review the mathematical procedures that are relevant to this assignment.
  - Review mathematical terminology.

- If students have difficulty solving practical problems:
  - Have students identify each piece of given information and what is asked for to solve the problem.
  - Have students identify relationships between given information and the solution.
  - Review indicated mathematical functions.
  - Discuss the importance of having this information to selling fruit and nut crops.
  - Have students discuss the consequences of NOT knowing how to determine the feasibility of a PYO farm.

- If students have difficulty investigating employment prospects of a career field/occupation:
  - Suggest they read current information on the career field.
  - Suggest they discuss the career field with a professional.
  - Have them list questions they have about the career field.

- If students have difficulty gaining, collecting, or recording factual information or data:
  - Instruct them to read or examine their sources carefully, and take good notes.
  - Remind them of the importance of recording data precisely.
  - Review sources of information, including area government agencies, the library, farming organizations, etc.
- If students have difficulty interpreting maps/globes:
  - Examine and define the various components of a map.
  - Discuss the purpose of the map.
  - Discuss the types of information that can be conveyed by a map.
  - Review the orientation, legend, and scale of the map.
  - Demonstrate how to determine mileage and designate radius.
- If students have difficulty analyzing/interpreting demographic information:
  - Have students identify as many separate pieces of information as they can, noting patterns and arrangement.
  - Have students arrange information in their own notes in a manner that makes sense to them.
  - Team students and encourage brainstorming and other creative processes.
- If students have difficulty analyzing consumer issues:
  - Introduce sources of consumer information and discuss the purpose of each.
  - Identify sources of consumer information.
  - Have students analyze more familiar pieces of consumer information.

ASSIGNMENT SHEET 1 | SELL FRUIT AND NUT CROPS | XII

Name ______________________ Score __________

OBJECTIVE 10

Write a newspaper advertisement for a pick-your-own operation.

INTRODUCTION

Advertising is extremely important when trying to attract customers to a fruit-picking site. Often, growers advertise for potential customers in local newspapers. When writing an ad, you must remember to include: name of business, location, business hours, working days, types of produce, telephone number, and any "extras" such as a picnic or play area. Including the price of the produce is optional. However, prices should be made clear at the picking site.

Cognitive Activities Skills

- Create a finished product
- Apply intuitive thinking techniques

EXAMPLE:

ANNIE'S U-PICK APPLES
1117 Apple Valley Road, Appleville, OK
Open 7 days a week, 9 a.m. to 4 p.m.
405-555-2222

Pick'em Fresh !!!
Golden Delicious - Jonathan

We also sell fresh cider, apple dolls, and other goodies

DIRECTIONS

Use a separate sheet of paper to write your advertisement. Remember to include all the necessary information. Be creative!

ASSIGNMENT SHEET 2

SELL FRUIT AND NUT CROPS

XII

NAME ______________________________ SCORE__________

OBJECTIVE 11

Determine the feasibility of a pick-your-own strawberry farm.

INTRODUCTION

Before getting involved in a pick-your-own operation, a grower must determine whether he or she can profit from such a venture. The grower must check into the population of the area and the possible competition. Remember, good roads and highways will benefit the operation; poor roads, rivers and other obstacles will cut down participation.

DIRECTIONS

Research and Reference Skills
- Find materials in library
- Use standard references
- Use in-book reference tools

Operation and Calculation Skills
- Calculate with whole numbers

Math Application Skills
- Select/apply mathematical formula

Functional Math Skills
- Solve practical problems

Job Search/ Selection Skills
- Investigate employment prospects of a career field/ occupation

1. Pick a site on a map for your pick-your-own operation. On a map, circle a 20-mile radius around that location. Include cities, towns and rural populations that have direct and convenient access by car. The circle does not have to be perfectly round.

2. Calculate the number of potential pick-your-own customers that live within the circled area. If your map does not have population information, obtain census data from the local library or courthouse.

   Write the number of potential customers here: ___________

3. Determine the number of existing pick-your-own strawberry acres within the circle and also within 5 miles of the radius on your map. Your local cooperative extension can help if you don't know.

   Write the number of existing acres here: __________

4. Use the Supplement 1 to find the number of acres in strawberries that corresponds to your population area.

   Write the number of acres here: _________

   EXAMPLE: If there are 10,000 people within your trade area, you could plant 4 acres of strawberries, as long as there are no other pick-your-own strawberry growers within the vicinity.

Information Analysis Skills

- Collect/record data
- Interpret maps/globs
- Analyze/interpret demographic information

5. Subtract the acres already planted by other growers from the potential acres for your area/population. This will give you the number of acres you could plant for a pick-your-own operation.

Write the number of acres here: __________

ASSIGNMENT SHEET ANSWERS

SELL FRUIT AND NUT CROPS

XII

ASSIGNMENT SHEET 1

The ads should include name of business, location, business hours, working days, types of produce, telephone number, and any "extras" that are relevant.

ASSIGNMENT SHEET 2

Check to see that student has:

1. Correctly circled a 20-mile radius around the location he/she picked.
2. Correctly calculated the number of potential pick-your-own customers that live within the circled area.
3. Determined the number of existing pick-your-own strawberry acres within the circle and within a 5-mile radius.
4. Used the table correctly to find the number of acres of strawberries that correspond to the population area.
5. Subtracted the acres already planted by other growers from the potential acres for the area/population to give the number of acres that could be planted on the site.

WRITTEN TEST

SELL FRUIT AND NUT CROPS

XII

NAME ______________________________ SCORE ________

OBJECTIVE 1

Match terms associated with selling fruit and nut crops to their correct definitions. Write the correct letters in the blanks.

_____ 1. Growers deal directly with the final consumers when selling their produce

_____ 2. Buyer of a product who sells to the final consumer

_____ 3. When selling their produce, growers deal with an intermediary or "middleman" rather than directly with consumers

_____ 4. Percentage of money earned, usually by a broker or salesperson, when a product is sold

_____ 5. Legal responsibility or obligation to make good on any loss or damage that might occur because of negligence

a. commission

b. bonus

c. direct marketing

d. rural marketing

e. retailer

f. non-direct marketing

g. liable

h. liability

OBJECTIVE 2

List advantages and disadvantages of direct marketing and non-direct marketing. Give four examples of each.

DIRECT MARKETING

Advantages:

1. ______________________________

2. ______________________________

3. ______________________________

4. ______________________________

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Disadvantages:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

NON-DIRECT MARKETING

Advantages:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

Disadvantages:

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________

OBJECTIVE 3

Match types of non-direct markets to statements describing them. Write the letters of the correct answers in the blanks. You may use more than one letter for each answer and each letter may be used more than once.

_____ 1. Generally contract with growers to buy their produce and then redistribute it after it has gone through canning, freezing, etc.

_____ 2. Does not buy produce outright

_____ 3. Handles large quantities of produce from growers and then sells the product to others who plan to resell it

a. terminal market
b. wholesaler
c. mail order
d. processors
e. cooperative
f. retail outlets
g. private packing facilities
h. brokers

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_____ 4. Assembly and distribution center in a large metropolitan area

_____ 5. An institution that purchases produce directly from the grower

_____ 6. Grades, packs, cools, and sells produce for growers

_____ 7. May provide harvest assistance

_____ 8. Involves the membership of numerous growers; members pool their produce to meet buyer requirements they may not be able to meet alone

_____ 9. Means of providing "packaged" produce or gift packs through catalogs or local advertisements

OBJECTIVE 4

Describe types of direct markets. Write your answers in the blanks.

1. Pick-your-own – ______________________________
   ____
   ____
2. Roadside markets – ____________________________
   ____
   ____
3. Farmers' market – _____________________________
   ____
   ____

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OBJECTIVE 5

Complete sentences explaining considerations in establishing a direct market. Write the correct answers in the blanks.

1. **Advertising and promotion** – Growers need to ______________ their products through means such as ______________ signs, billboards, flyers, newspaper and radio advertisements, and ______________ ______________ such as postcards.

2. **Pricing** – Growers often use ______________ prices as a way to determine prices for their produce. Produce can be sold by ________________, ____________________, or ______________ (per item). Producers need to take into account production costs, expected sales, and yields when setting their selling prices.

3. **Optional facilities** – Grower can make their operations more ________________ to customers by providing such services as restrooms, ______________ ________________, play areas for children, refreshments, and rest or recreation areas.

4. **Containers** – Growers need to supply ________________ ______________ that will not harm the fruit and are easy for pickers to ______________. To cut costs, some types of fruits can be transferred to less expensive containers, such as paper or plastic bags, after being purchased.

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5. **Labor** – The type and amount of labor needed will depend on the ________________. Most pick-your-own facilities will need, at minimum, people to supervise ________________ in the field and ____________ ______________ operators to give directions and take payments.

6. **Liability** – When growers open their land to the public, they ________________ their liability. Producers need to do all they can to make sure their ________________ is safe, and check with their insurance agents to make sure they have proper coverage.

7. **Location** – Sites should be ________________, and directions should be clear. Growers need to consider possible ________________ from other nearby operations and determine the number of potential customers in the area.

8. **Consumer Interest** – Growers need to consider the type of ________________ in the area and their reasons for visiting a pick-your-own operation, produce stand, or farmers' market. Reasons may include______________ prices,______________ produce, and variety.

9. **Quality** – Quality of produce is important because it can determine how many customers will visit an operation. Quality also determines the ________________ a grower can set, the number of ________________ ____________, and the word-of-mouth advertising a grower can expect.

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OBJECTIVE 6 **Select from a list true statements regarding direct marketing liability.** Place an "X" in front of true statements.

_____ 1. A grower's responsibility in the case of a social guest is to avoid "willful and wanton" misconduct.

_____ 2. Growers are not liable to an injured customer if they have insurance.

_____ 3. Growers are not responsible for the produce they sell once it has been purchased by the customer.

_____ 4. Actual damages are awarded when a person or company has acted recklessly.

_____ 5. Actual damages could include the cost of medical bills, lost wages, and pain and suffering.

_____ 6. One way to reduce liability risks is to survey property for problem areas and hazards.

_____ 7. Growers don't need insurance if they run a pick-your-own operation.

_____ 8. Under workman's compensation laws, injured workers can collect damages, no matter who was at fault.

OBJECTIVE 7 **Select from a list various resources for growers**. Place an "X" in front of the number of each correct answer.

_____ 1. Elementary schools

_____ 3. The Green Book

_____ 3. Cost-of-living index

_____ 4. Local colleges and universities

_____ 5. The Packer's Red Book

_____ 6. Cooperative extension services

_____ 7. Wall Street brokers

_____ 8. The Blue Book

_____ 9. Growers' Associations

_____ 10. Agricultural Futures Act

_____ 11. Perishable Agricultural Commodity Act

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OBJECTIVE 8 **Identify attributes of a good employee.** Write an "X" in the blank before each attribute of a good employee.

_____ 1. Dresses appropriately for the job

_____ 2. Leaves the job early when all work is completed

_____ 3. Greets customers in a personal and friendly manner

_____ 4. Always shows up for the job on time

_____ 5. Never speaks to a supervisor unless spoken to first

_____ 6. Notifies or discusses with employer well in advance plans for a vacation

_____ 7. Keeps a positive attitude on the job

OBJECTIVE 9 **Identify characteristics of a good supervisor.** Write an "X" in the blank before each characteristic of a good supervisor.

_____ 1. Ability to deal with many personalities

_____ 2. Ability to treat each employee with respect

_____ 3. College degree in business management

_____ 4. Ability to motivate employees to perform to the best of their ability

_____ 5. Ability to project the attitude that "I'm the boss and employees better listen to me no matter what "

_____ 6. Meets with employees only when there is a problem

_____ 7. Takes a personal interest in each employee

_____ 8. Ability to listen to complaints or comments of employees

---

NOTE: Objectives 10 and 11 are evaluated on assignment sheets in this unit. If you have not completed this component, see your instructor.

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WRITTEN TEST ANSWERS

SELL FRUIT AND NUT CROPS

XII

OBJECTIVE 1

1. c
2. e
3. f
4. a
5. h

OBJECTIVE 2

Answer must include four advantages and disadvantages from each of the following areas:

DIRECT MARKETING

Advantages:

- Lower transportation costs
- Special containers may not be needed
- Produce need not be of all the same grade
- Producers can offer "recreation" at selling sites
- High-quality produce is sold for competitive retail prices
- Payment is received at time of sale

Disadvantages:

- Liable for accidents on property
- Must attract a certain volume of customers to meet expenses
- Need good location and facilities (weigh stations, restrooms, etc.)
- Must deal directly with customer
- Requires more personal time
- Harvesting throughout growing season requires more production planning

- Additional labor may be needed for selling, field assistance

NON-DIRECT MARKETING

Advantages:

- Large number of potential buyers
- Can sell most or all of crop at one time
- Produce can be sold quickly
- Less personal time required
- Market information available

Disadvantages:

- High quality, uniform produce needed
- Special containers often required
- Large quantities needed to cover transportation costs
- Payment usually not received at time of delivery

OBJECTIVE 3

1. d
2. h
3. b
4. a
5. f
6. g
7. d, e, or g (or any combination)
8. e
9. c

OBJECTIVE 4

1. Pick-your-own – operation in which a grower allows consumers to harvest their produce from his/her fields or orchards
2. Roadside markets – facility, usually on the grower's property, used to sell locally grown produce or produce purchased from nearby growers; market is usually on a well-traveled roadway to attract passersby
3. Farmers' markets – outlet for growers to sell produce directly to consumers; buyers are usually attracted by the variety of produce sold at one location; growers are usually assessed a fee to sell the produce.

OBJECTIVE 5

1. promote, roadside, direct
2. competitors', weight, volume, count
3. attractive, picnic tables
4. sturdy containers, carry
5. operation, pickers, check station
6. increase, property
7. well-marked, competition
8. residents, lower, fresher
9. price, repeat sales

OBJECTIVE 6 1, 5, 6, 8

OBJECTIVE 7 4, 5, 6, 8, 9, 11

OBJECTIVE 8 1, 3, 4, 6, 7

OBJECTIVE 9 1, 2, 4, 7, 8

FRUIT AND NUT PRODUCTION

READING SKILLS

UNITS OF INSTRUCTION STATE/LOCAL CODES*	Reading Comprehension									Research and Reference								Functional Reading						Language		Composition					
	Gain needed information	Distinguish fact, opinion and inference	Recognize stereotyping and bias	Recognize propaganda	Analyze cause and effect	Draw conclusions	Make generalizations	React to written material	Apply word analysis techniques	Select useful resources	Locate resources	Find materials in library	Use standard references	Use in-book reference tools	Use audiovisual media	Use computer data bank	Use magazines and newspapers	Interpret forms and records	Follow written instructions	Interpret graphics and symbols	Use content area vocabulary	Interpret abbreviations/acronyms	Read aloud	Use standard grammar and correct spelling, punctuation, and capitalization	State ideas clearly	Use complete sentences	Develop preliminary outline	Use topic sentences	Use introductory/closing paragraphs	Compose reports	Compose essays
Identify Fruits and Nuts														●						●											
Select a Site for Fruit and Nut Crops														●						●											
Prepare a Site for Fruit and Nut Production																															
Propagate and Plant Fruits and Nuts																			●												
Maintain Fruit and Nut Crops	●													●					●												
Fertilize Fruits and Nuts	●																		●			●									
Irrigate Fruit and Nut Crops																			●												
Control Pests in Fruit and Nut Production																			●												
Harvest Fruit and Nuts																			●												
Perform Post-Harvest Functions																			●					●	●	●				●	
Take Inventory, Ship, and Maintain Merchandise																		●													
Sell Fruit and Nut Crops												●	●	●																	

*Use this line for entering your state and local codes for graduation requirements or learner outcomes.

CIMC BASIC SKILLS DOCUME

WRITING SKILLS																																													
Composition						Research					Functional Writing							Operation and Calculation														Math Application													
Use topic sentences	Use introductory/closing paragraphs	Compose reports	Compose essays	Proofread and edit	Construct graphics and symbols	Take notes	Use notecards	Create bibliography	Use footnotes	Outline material	Complete forms and records	Write instructions	Write letters	Write job applications	Write resumes	Use word processing	Use computer graphics	Round off numbers	Estimate answers	Use scientific notation	Use exponential notations	Calculate with whole numbers	Calculate with fractions	Calculate with decimals	Convert whole numbers to fractions	Convert whole numbers to decimals	Solve numerical expressions	Solve formulas and equations	Obtain squares and square roots	Convert units of measure	Perform metric calculations	Solve word problems	Select/apply mathematical formula	Select/apply mathematical procedure	Use English and metric measures	Solve time/rate/distance problems	Solve ratio/proportion problems	Solve percent problems	Apply techniques of scaling	Apply algebra principles	Apply geometry principles	Apply trigonometry principles	Interpret charts and tables	Interpret graphs (type)	Collect/record data
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ENTATION MATRIX

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MATH SKILLS

SCIENCE SK

Data Analysis and Display								Functional Math														General Science									Life Science							Physical Science				
Collect/record data	Apply sampling techniques	Apply principles of probability	Construct charts and tables	Construct graphs	Calculate statistics	Interpret statistics	Interpret blueprints/plans	Make measurements	Perform banking transactions	Make change	Solve practical problems	Calculate gross earnings	Solve income/expense problems	Prepare a budget	Calculate interest	Solve interest problems	Calculate sales tax	Determine income tax	Use calculator for computation	Use computer for computation	Use computer spreadsheets	Apply computing skills	Apply scientific method of inquiry	Conduct experiments	Investigate science ethics	Investigate science history	Investigate/apply economics in technology	Use scientific instruments	Investigate/apply technology	Collect specimens	Identify/classify living organisms	Investigate biological history of the earth	Investigate food chains, webs, pyramids	Investigate/apply principles of human development	Investigate/apply principles of genetics/heredity	Investigate/apply principles of anatomy/physiology	Investigate health issues	Analyze/classify matter	Investigate forms/changes of matter	Investigate forms/changes of energy	Investigate/apply chemical properties	Investigate/apply physical laws
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OKLAHOMA DEPARTMENT OF
VOCATIONAL AND TECHNICAL EDUCATION
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

SCIENCE SKILLS

AGE031

93-009663

Physical Science					Earth Science							
Analyze/classify matter	Investigate forms/changes of matter	Investigate forms/changes of energy	Investigate/apply chemical properties	Investigate/apply physical laws	Investigate physical characteristics of the earth	Investigate geological history of the earth	Investigate physical forces acting on the earth	Solve problems of longitude, latitude, and time zones	Investigate conservation of physical resources	Investigate conservation of living resources	Investigate issues of environmental impact	Apply science principles to environmental issues
			●									
									●			
				●								

UNITS OF INSTRUCTION	ORAL COMMUNICATIONS SKILLS																							INT											
	Oral Presentation									Listening				Interactive Communication										General Relating											
STATE/LOCAL CODES*	Make informative presentations	Make persuasive presentations	Present personal opinion/viewpoint	Use good speaking techniques	Select/use words effectively	Use effective body language	Present appropriate appearance	Integrate audio and/or visual materials in oral presentations	Adapt presentation to specific audience	Apply active listening skills	Distinguish fact, opinion, and interference	Draw conclusions/make generalizations	Analyze/identify point of view	Give/follow oral directions	Apply questioning techniques	Conduct/receive interviews	Analyze/apply nonverbal communication	Work effectively in a group	Communicate with clients/customers/patients	Communicate with co-workers	Communicate with supervisors	Communicate with professional colleagues/associates	Apply telephone etiquette	Investigate/apply communication process models	Analyze/apply nonverbal communication	Investigate/apply cross-cultural communication	Interact with co-workers	Interact with supervisors	Interact with clients/customers/patients	Interact with professional colleagues/associates	Interact with family/friends	Participate in group activities	Participate in industrial relations/functions	Identify personal values/attitudes	Apply information to life experiences
Identify Fruits and Nuts																																			
Select a Site for Fruit and Nut Crops																																			
Prepare a Site for Fruit and Nut Production.																																			
Propagate and Plant Fruits and Nuts																																			
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Perform Post-Harvest Functions																																			
Take Inventory, Ship, and Maintain Merchandise																																			
Sell Fruit and Nut Crops																																			

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INTERPERSONAL OR RELATING SKILLS

- Participate in group activities
- Participate in industrial relations/functions
- Identify personal values/attitudes
- Apply information to life experiences

- Identify values/attitudes
- Identify needs/drives
- Select/apply appropriate behavior
- Investigate/identify personal styles
- Investigate/identify group/ corporate climate
- Give/receive feedback
- Identify hidden purposes
- Investigate/apply group dynamics
- Control undesirable/ inappropriate behavior
- Resolve conflicts
- Clarify goals/objectives
- Devise "win/win" situations
- Build consensus
- Generate ideas
- Present point of view

Teamwork Cooperation

Leadership Influence

- Analyze/apply leadership styles
- Analyze/apply management styles
- Obtain confidence of others
- Develop esteem in self/others
- Persuade others
- Analyze/apply motivation techniques
- Provide positive coaching

CREATIVE THINKING/ PROBLEM SOLVING SKILL

Cognitive Activities

- Collect/record information
- Identify critical elements/issues
- Define a problem
- Identify underlying causes
- Apply a problem-solving model
- Analyze/synthesize information
- Identify/analyze underlying assumptions
- Draw conclusions
- Predict results/outcomes
- Identify/evaluate consequences
- Identify/develop alternatives
- Evaluate alternatives
- Select an alternative
- Devise a solution
- Create a finished product
- Apply intuitive/creative thinking processes
- Transfer knowledge/training to new situations
- Apply new technology
- Develop an action plan
- Evaluate results/outcomes

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EMPLOYABILITY SKILLS																												SOCIAL S									
Job Search Selection								Job Acquisition Development														Information Analysis						Social Studies Application									
Analyze personal occupational aptitudes/preferences	Investigate employment prospects of a career field/occupation	Investigate training requirements for a career field/occupation	Investigate benefits of a career field/occupation	Compare/evaluate career options	Develop personal career path	Locate appropriate jobs	Analyze duties/requirements/benefits of specific job	Master specific job task/procedure	Fill in job related applications	Write letter of application	Write personal resume	Interview for a job	Apply business etiquette	Practice good work habits/attitudes	Develop good personal presentation	Develop self-confidence/esteem	Develop effective leadership	Deal effectively with supervisors	Deal effectively with co-workers	Deal effectively with professional colleagues/associates	Deal effectively with customers/clients	Collect/record data	Interpret graphical information	Construct graphical information	Interpret maps/globes	Interpret statistical information	Analyze/interpret demographic information	Investigate/apply U.S. history	Investigate/apply world history	Investigate/apply U.S. geography	Investigate/apply world geography	Investigate/apply principles of government/politics	Investigate/apply principles of economics	Investigate/apply principles of ethics	Investigate/apply principles of psychology	Investigate/apply principles of sociology	Investigate/apply cross cultural studies
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SOCIAL STUDIES SKILLS

Social Studies Application													
Investigate/apply U.S. history													
Investigate/apply world history													
Investigate/apply U.S. geography													
Investigate/apply world geography													
[illegible] government/politics [illegible]													
Investigate/apply principles of economics													
Investigate/apply principles of ethics													
Investigate/apply principles of psychology													
Investigate/apply principles of sociology													
Investigate/apply cross cultural studies													
Functional Social Studies													
Practice responsible personal economics													
Prepare a personal budget													
Use credit responsibly													
Practice good work ethics													
Participate in industrial relations													
Interact with people of different races/cultures													
Investigate/participate in government													
Investigate/apply American legal practices													
[illegible] sources of information on current events													
Analyze current events													
Analyze consumer issues													
Analyze social issues													
Analyze conservation/ecology issues													
Analyze social impact of science/technology													
Analyze economic impact of science/technology													

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